Sense - Recommendation System based on Affective Interpretations of Social Media Posts: A Proposed User Interface Design

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Abstract

It is now easier and cheaper for people to get involved in technology, and most people are obtaining or receiving tons of information nowadays, such as recommendations. Different recommendations are filled with our devices like smartphones, tablets or even wearable devices. However, most searches and recommendation systems fail to take into consideration the emotional context related to a user's input and action, and as a consequence, people can hardly receive personalized, emotion-related, user-based recommendations. Though people are given various choices about lives based on searches and saved data, those recommendations can hardly improve the stress and difficulties of accomplishing daily life goals caused by the developing of technology. Therefore, People need more user-centered recommendations that incorporate emotion and action related evaluations to reach more precise results.

This thesis project presents a possible design solution to improve this situation. An affective recommendation system designed to determine a person's emotional state or condition based on the affective interpretations of their social media content. Combining bio information, exercise or activity records, it provides personalized recommendations like food, entertainment, activities or exercise suggestions related to the users.

This project demonstrates how a new user-centered, emotion and activity based recommendation system can leverage elements of emerging technologies such as conversational User Interfaces (CUI), context recognition, and expression recognition to create a more user-friendly and more meaningful experience.

Keywords: recommendation system, affective system, affective interpretation, emerging technology, conversational user interface
To my parents, mentors, friends and people I love.
Thank you.
Introduction

The overuse of smart devices as a primary tool for communications is creating a reduction for interpersonal relationships and direct communication, which may be the sources of displeasure or pressure. The time spent on social media, content consumption, entertainment, and searches can be overwhelming, and are having a direct negative impact on lifestyles.

Once people receive negative feedbacks caused by this situation like feeling overwhelmed, unpleasant or even stressed, people are getting used to seeking solutions online. If we can regard the solutions as a kind of recommendation, it is easy to find that there are several types of recommendations in lives, for instance, food, entertainment, online or offline activities or exercises. In many scenarios, people get recommendations from search and recommendation systems, and people usually need specific recommendations which they may be not aware of. However, most of them do not consider the emotional context related to a user’s input and action, which means, they can hardly provide results linked to a user or person as an original spirit.

This thesis project explores a multi-platform experience which provides different recommendations based on their emotion and action for people. As the final solution, I design a system that analyzes emotion and action based on people’s social network posts and contents to provide different recommendations related to people. This solution aims to encourage people to explore their lives, improve their lifestyles, and promote life quality by providing them with better and more comprehensive searches and recommendations.

From this perspective, multi fields research should be involved. Inquiries about content analyze mechanisms including text recognition in context, the connection between emotion and visual aspects. This thesis project focuses on User Experience (UX), visual study including color and motion design to create the user interface which can fit multi-platforms. This project tries to build conversational User Interfaces (CUI) experience, which minimizes the interaction in this project. The visual study is used to reveal
the relationship between people’s emotions and color. Motion design is created to contribute to the reflection of emotion.

These experimental simulations will investigate the connections between motions, interface communication and user’s emotional flow cooperating with emerging technology that could be applied to real life. In the final stage, a simulation video of animated interface design and explanation of affective modification or emotional regulation processes will be presented.
Context

Situation analysis

Because of the conceptual framework of this project, multiple topics are involved in situation analysis research to present the context of the project. The following topics discuss the problems, data source, methodologies of the solution, and project feature.

Problem Statement

Based on the integrated systems of the mobile device and the additional time spent online, people are receiving massive amounts of information every day from different platforms, including a mass of repetitive or similar news, shopping information, video, or updates, which divert people’s attention and diffuse one’s energies. We can notice that a significant amount of time is spent on apps, contents, entertainments or platforms (Media 2018).

Apparently, We are moving our lives, especially social lives from offline to online in a rapid way. Because of that, we spend less and less time communicating and interacting with people physically. Surveys and researches show the overload of information and the absence of direct interactions are increasing people’s nervousness and stress level in an inconspicuous way (Tokunaga and Rains 2010). Besides, due to the division of time, people are more likely to spend their time in an unhealthy, less meaningful way. It becomes harder for people to form a healthy lifestyle or habit. For instance, report of CNN indicates smartphone may be hurting people’s sleep, peculiarly when people use their smartphone before bedtime (Scutti 2017). As a matter of fact, current user interfaces and interactions experience do not have a way to respond to people’s behaviors, mood or emotional states. This disconnection amplifies the unhealthy aspects of too much screen time.

These problems are gradually growing in discussions in recent years. More and more people realize that the overload of information and the absence of direct interactions are causing stress. Even if people know about the
problem, it can be overwhelming and challenging to find the most helpful solution. There are some technology methodologies out there to help people today, such as Notifications Management, Screen Time Monitor or App Time Control, and Activity Tracking. They help people filter the information they are receiving, prevent them from overuse or addiction of devices and Apps, and keep them active in their lives. However, these methodologies are not active, and people still need to spend time making decisions and tracking their activity.

I think the solution is providing personalized, emotion and action related recommendations for people when they need. However, most search and recommendation systems have difficulties offering people with results or recommendations based on how they are feeling and what they have behaved. This situation becomes the key problem that needs to be solved in the project.

Social media and data sharing

Social media has become one of the most important parts of people’s internet lives. In fact, average 30 billion pieces of content was updated and 2.7 billion likes and comments was posted every day on Facebook in 2012 (Sagiroglu and Sinanc 2013). Also, based on the source of Facebook, 1.49 billion people on average log onto Facebook daily and are considered daily active users in September 2018, which represents a 9 percent increase year-over-year (Facebook Investor Relations 2018).

People share the massive amount of information on the internet, whether personal or impersonal. Because of the revolution of social media platform, people are able to insert text, sound, photos, video and location in their posts. If people are using high-performance devices, or wearable devices like Apple Watch, they can even share Virtual Reality, Augmented Reality, and biological information on capable social media platforms. This not only broadens the limit how people can share content but also bring new opportunities for different service providers. For instance, based on the interactions such as view, like, follow made by a user during consuming tremendous information on social media, the service providers may understand some interests of the user, and according to that, they can provide the user with more personal customized services. Another example is the location information. If a user provides location information to a service provider, it can offer more services like restaurant recommendation near this user, which is known as Location Based Services (LBS). As
the developing of online services, legal data sharing and processing are playing a more important role.

This project uses shared data similarly. The data from social media platforms is used to extract users’ behaviors and interests, and determine users’ emotion. The results act as a key basis for the recommendations provided.

**How technology predict behavior of users and influence people’s lives**

As is mentioned before, people are creating, using and consuming more and more information every day. Even though people have access to a huge quantity of data as mentioned above, it is not yet being effectively processed to meet the needs of the user.

To achieve this, computer systems do not only need to understand the information the user consumes and interactions the user made but also comprehend why they made them. With the rise of Cloud Computing, Artificial Intelligence (AI), and Machine Learning, computer systems have the ability to learn and understand the information and interaction pattern of the user in a short time. As an example, when we reply or write emails via Gmail, Gmail can use the feature called “Smart Compose” to offer sentence completion suggestions for us. It predicts what people are going to type when they are responding or drafting based on the information of the email and what they have already written (Smart Compose: Using Neural Networks to Help Write Emails 2018).

Besides the ability to learn the information and interaction pattern, computer systems are expected to know people’s emotional state for more complicated interaction. It is challenging because the human feelings is complex, and the representative data is hard to determine. Even so, there are some new approaches for the development like Text Analytics from Microsoft Azure (Ashmaka 2018), and Sentiment and Emotion Analysis AI API from ParallelDots. They detect sentiment, keywords or phrases, and languages from the text people posted, and by doing that, the algorithms can process the result that shows the possibility whether the text is positive, neutral or negative (Gupta 2018).

Since the computer could have the power to understand people’s conversation and feelings, it is more likely expected to act as a real
“person”. It can join in social interactions with people more naturally by interacting and communicating with people. That is also a great opportunity for the computer to learn human beings’ behavior deeply but rapidly. These enhanced capabilities and information evaluation can influence affective regulation or modification when users interact with devices. For example, it can talk in the way that people are interested in, or it can provide the favorite music for people when it realizes that they are in a bad mood. In this way, the computer has the potential to change people’s behavior physically. As an example, besides monitoring the screen time, it can offer more detailed plans that people may be happier with, and try to persuade people to join them. In this way, it increases the opportunity that people may interact with the real world.

Search engines and the feature

As we know, early search engines required people to type exact words to get desired results. With the development of Big Data and Cloud analysis technology, people could find what they need using a few related words or phrases. Now, with voice assistants like Siri, people can talk to their devices just like they would talk to a real person. I propose the next step is an affective recommendation system, which would actively recommend something that people might need, but they did not think about or search for yet. This mechanism provides the experience that is similar to interpersonal interaction.

Proposed solution

Based on situation analysis, this thesis project focuses on the problem that most search and recommendation systems fail to consider people’s emotion and action. Therefore, they may not offer people with user-centered, emotion and action related recommendations. At the same time, the proposed solution covers two additional problems. First, long-time Internet use and excessive social information may lead to a certain scale of nervousness or even more severe problems. Second, By creating a solution that utilizes sentiment analysis, emotion analysis and affective regulation, the solution can generate recommendations more effectively and engage with users to improve their lifestyle.

In this thesis project, the proposed solution to the problems comes from social media platforms. People need appropriate feedbacks to improve this situation. These feedbacks could be arisen along with recommendations.
associated with their affective aspects and actions, which are the proper methodologies for adjusting or keeping a person's emotions. These recommendations could even achieve affective modification or emotional regulation. By analyzing people's social media contents, working with other details of people's lives like bio information, exercise activity record, an affective recommendation system that can foresee users' lifestyle patterns on multiple continuums is built in this thesis project as the possible solution. While the system interprets and suggests, the user can respond to the system more naturally using much fewer efforts. The whole experience turns from passive to active.

Moreover, even already active or positive people could still benefit from this system. It can make recommendations such as nutritional foods, athletic activities, relaxing music or entertainment to help people maintain a healthy lifestyle. A series of goals could be set to present a plan for people's lives, which is another way to offer feedbacks.

**Inquiries**

Based on the proposed solution, there are four Inquiries need to be considered and explained in design result.

*Inquiry 01*  
How could the system provide recommendations that respond to a user's emotions and actions?

*Inquiry 02*  
How could the system present its emotions and modify users’ feeling?

*Inquiry 03*  
How could the system help users build a better and more healthy lifestyle?

*Inquiry 04*  
How could users interact with Sense?

**Target audience definition**

According to the information gathered, the target audience can be defined. The target audience of this system is people who want to receive recommendations based on their preferences, or people who feel stressed about the overuse of the devices and excess information.

There is no preference sex of target audience. Moreover, the primary age range of the target audience is 17 to 55. The education level of the target audience is expected as above high school.
Since the problems and Inquiries are defined in the early stage of the project, the design flow helps to examine the research and find a feasible design solution. It divides into three parts, which are design ideation, project implementation, and final design solution. Project implementation includes function model, flowchart, use case, visual study, design exploration and low-fidelity wireframe.

**Methods**

**Design ideation**

Sketches (Figure 1) are made to demonstrate potential interactions, scenario, and visual aspects. As a result, emotion can link with conversation, voice, facial expression, and movements. Conversation, voice, facial expression can be input and recognized using the devices. Movements can be regarded as the gesture pattern that is defined by users. For the scenario, it needs to be considered how the system understand users’ action and emotion when there is not social media update from users since the system uses affective interpretation results of social media post as the basis of users’ action and emotion.

*Figure 1. Design ideation sketches*
The name of the system is “Sense”, which means it can be a sensitive and intelligent system. The system is mainly presenting as an iOS app in this project. In order to bring more interpersonal, more natural and more emotion-related experience to people (Techlabs 2017), I decide to use conversational User Interfaces (CUI) as the main pattern cooperating with the multiple interactions I list in the brainstorm. It does not only minimize the user experience but also simplify the information flow for users.

As for the visual style, Sense needs to be shaped like a living spirit in people’s devices. It means Sense will have its own emotion responding to people’s actions and feelings. Thus, the idea for the visual style is to use color representing its emotion. The organic and dynamic shapes are emphasizing the living states. Because it is proposed to be a CUI design, the conversational elements need to be presented with organic animation to match the style.

Project implementation

I create function model, flowchart, use case to figure out explanations for the inquiry 01 (How could the system provide recommendations that respond to user’s emotions and actions?).

Function Model

Function model intends to demonstrate how Sense works internally. As is shown in Figure 2, social media posts from different platforms are gathered to process to sentiment and emotion analysis APIs. Sentiment and emotion analysis APIs calculated the emotion index, which represented the basic feeling of a user, according to the contents of social media posts.

Also, personal profiles are collected from social media posts to let the system know the interests and important moments such as birthday and anniversary of the user. Search history and goals are used to reveal the recent events that user may be concerned about.

At the same time, if the user has devices that can record her or his biological information (bio information), like activity, sleep status, and heart rate, the system can use these to know and determine whether the user is in a normal
status. So at the final stage, according to the emotion index, interests and moments, working with search history, bio information, and goals, Sense can present the recommendations designed for a specific person.

Figure 2. Function Model
Flowchart

The Flowchart shows the experience loop in this system. It indicates the flow of the user’s interaction steps. As is shown in Figure 3, the flowchart consists of three parts. The part in yellow presents the landing pages when users first use Sense. The part in green shows the how Sense reacts to the affective interpretation of users’ social media posts, or respond to the communication with users. Red part indicates the interaction processes of users.

Use Case

Three main use cases are listed in Figure 4 by separating the Flowchart. The first flow shows how users connect their social media and set their preferences. This flow provides Sense with the data source of social media information, goals, and gesture recognition. When users finish this flow, Sense will receive information from the steps and prepare for the first conversation. The following two flows show two different scenarios how
users interact with Sense. If users update their social media, Sense will use algorithms to collect the results of affective interpretations based on the new update and start with the first conversation. Otherwise, Sense will communicate with users first asking about users’ emotion and actions. Meanwhile, it will collect users’ inputs such as voice, facial expression, and gestures. According to the results of affective interpretation and recognition, it begins with the first conversation. Then, users can interact with Sense, and respond to the conversation or recommendation. If there’s an update for the conversation, users will receive the update as a notification. After opening the conversation update, users may have further responses to Sense. These use cases represent the key features, challenges and benefits of the proposed model or system.

Figure 4. Use Case
Visual Study

Visual study is aimed to find the solution for Inquiry 02 (How could the system present its emotions and modify users' feeling?). As I propose in design ideation, the study discovers the elements such as color, shape, and visual pattern.

Color theory

Colors are positive signs of emotional expressions. Plutchik’s Wheel of Emotions is the color theory that is applied to the project. In 1980, Robert Plutchik constructed a wheel-like diagram of emotions visualizing eight basic emotions: joy, trust, fear, surprise, sadness, disgust, anger, and anticipation (Contrasting and categorization of emotions 2018). For example, green can convey the feeling of trust, bright yellow can express the feeling of joy, and bright blue can express the feeling of amazement.

Because of the complexity of the human being's emotions, various human feelings are combinations of basic emotions. For instance, love is the combination of joy and trust, pleasant is the combination of joy and interest, and delight is the combination of trust and surprise (Figure 5).

Figure 5. Color Combinations
Color Usage

When Sense needs to express its emotion, it can use the color combination consists of 1-3 color representing this emotion. In this way, Sense is able to respond to users more vividly and affectively.

Also, Color changes indicate how is the feeling of Sense changing based on the color theory applied to the project (Figure 6). Sense is responding user’s action or emotion. It is not merely reflecting how user feel.

Figure 6. Color Change
**Shape and Pattern**

Sense reveals as a blurred, organic and dynamic shape. It is expected to express the feeling of a living soul in devices. At the same time, Sense uses various patterns to amplify its emotion. As an example, “wave” is working with happy emotion, “chaos” shows when Sense feels angry, and “distort” represents sad. The text on CUI is also displayed in different text animations according to different emotions (Figure 7).

![Figure 7. Shape and Pattern](image)
Design Exploration

Different design decisions are conducted for the design exploration. These intend to build the possible low-fidelity or high-fidelity design prototypes according to problem subdivision and visual study.

Exploration 01  
(Figure 8) As is mentioned in the visual study, recommendations are displayed in the dynamic shape combining different colors related to emotions. The user needs to respond to the recommendation by press the emotion-metaphorical buttons changed based on the recommendation. At the same time, a user can long press the button to call out input box and type what they want to say to Sense.

This exploration is traditional but easy for users to follow. The disadvantage is that the responses are limited and not engaging.

Exploration 02  
(Figure 9) People can create and draw the response patterns on the screen. There’s no exact interaction limit. The shape of Sense would respond to the gestures the user is drawing like Sense can feel how the user interact with it. It is a natural way of interaction.
Exploration 02 intends to find how users use gestures to interact with Sense. This experience needs a tutorial to let the user create the pattern before entering the system. Also, to ensure the accuracy, Sense needs other input sources for emotion recognition.

![Figure 9. Exploration 02](image)

**Exploration 03** Recommendations are displayed as dots. Each dot is an individual recommendation based on the results of affective interpretations of social media posts. This exploration tried to demonstrate how to build the relationship between recommendations and emotion-related graphic. But exploration 03 is more like a regular user interface. It lacks the human-like characteristics.

![Figure 10. Exploration 03](image)
**Low-fidelity wireframe**

The low-fidelity wireframe is created to support the final design solution, which follows the idea of exploration 02 (Figure 11). It shows how users create their emotion-metaphorical gestures, how Sense starts a new conversation and how users interact with it. Recommendation history and setting page are also showed in the wireframe.

![Figure 11. Low-fidelity wireframe](image)

**Final design solution**

After the prototype test of design explorations, I decided to remove all secondary pages and buttons in this system. The experience simply relies on the conversation-respond pattern. Also, gestures made by users will influence how Sense moves as it responds to the interaction simultaneously. These changes fit the use case scenarios more naturally. The final design video links are shown as follows.

- *Sense Demo*: [https://vimeo.com/274586716](https://vimeo.com/274586716)
- *Shape and Pattern*: [https://vimeo.com/274308513](https://vimeo.com/274308513)
- *Create Gestures*: [https://vimeo.com/274585621](https://vimeo.com/274585621)
Results

Features

“Affective” Search Engine
(Figure 12)

The system could offer various type of search results that respond to the user's emotions and actions based on the analysis.

The system can fundamentally understand what users think, how users feel and how to modify users’ emotions using design philosophy and methodology.

Figure 12. Affective” Search Engine

Goal Tracking
(Figure 13)

The system includes a goal tracking function that allows users to add their goals and provides more healthy and active recommendations for users. Users can set goals in this function, and Sense will offer more goal related recommendations for the users.
**Be with you and keep learning about you**
Sense will check users’ status by learning users’ bio information and users’ updates on the social network (Figure 13). Connecting the goal tracking system, it responds to users’ actions to help them form a better lifestyle.

**LBS**
LBS can help Sense to know where the user is. It helps Sense to give the user more localized and personalized recommendations. Combining with map data, Sense will use private cloud to search the nearby places, events or services to provide the user with more localized and personalized recommendations (Figure 14).
**Interactions**

Users could create or define their own gestures representing different meaning, such as like, dislike. Also, on this conversational User Interfaces (CUI), gestures could stand for different interactions like go back, switch (Figure 15).

Sense will check whether a user is talking to it. It will check the conversation content and emotion from the user’s sound. Sense will “talk” to you like your close friend. Based on what it learned from the user, it will know what she or he may need next (Figure 16).

Using facial expression recognition APIs, Sense will recognize users’ facial expressions when users are facing it using devices with front-camera. It is going to know how users are feeling at that moment.
Evaluation & Discussion

From the perspective of the evaluation, the final solution has explained and addressed the three inquiry came from the problem. Function model, flowchart and use cases explain how Sense provide recommendations that respond to user’s emotions and actions. Color selections based on color theory, dynamic shapes and patterns help Sense present its emotions and modify users’ feeling. Goal tracking function is designed to help users build a better and more healthy lifestyle. Multiple interactions such as gestures, voice recognition, and facial expression recognition are applied in Sense, which provides a rich experience and more accurate feedbacks for users.

As the part of the evaluation step, this thesis project is exhibited in Imagine RIT 2018, lots of feedbacks were received during the festival. Some of the questions and feedbacks are listed below.

Feedback 1  How would Sense act when it is in idle state?
Feedback 2  Sense may show more detailed information when I ordered something, such as price, quantity.
Feedback 3  Maybe it can control the smart home devices, like Alexa.
Feedback 4  How can I talk to it or how can it recognize the facial expression?

Also, this project is submitted to the Adobe Design Achievement Awards 2018. People are concerned about the privacy problems that are occurred in this system.

In response to feedback, four video demos are designed to demonstrate how people check more detailed information, how people talk to Sense, and how Sense recognizes the facial expression. New updates are listed as follows.

Get more information  Some recommendation may get updated. If the user wants to check more information, she or he can mark the dialog or keyword by drawing lines on it. The updated information will show in
the following conversation. The experience is built by natural way since the user can check the information by interacting with them directly.

Figure 17. Get more information

Update Demo Links

Get more information  https://vimeo.com/305005278
A Day with Sense  https://vimeo.com/305005746

How does Sense know you are smiling?  https://vimeo.com/297481770
How can you talk with Sense?  https://vimeo.com/297482102
Conclusions

Sense is an affective recommendation system that is designed to provide people with recommendations according to the result of affective interpretation of their social media posts. It is expected to help people with stress caused by overuse of their devices, difficulty of forming a good lifestyle, and exploration of their lives by offering recommendations that are related to people's emotion and actions. To approach this, Sense is applied with conversational User Interface, which brings more human-like experience to devices. Cooperating with multiple input methodologies such as gestures, voice, facial expression, users can interact with Sense more naturally and simply. The system can reflect emotion and show affective transformation using color, shape, and pattern, which is another design attempt for the affective recommendation system.

This thesis project is built on a conceptual framework, and the system is supported by different mechanisms. For example, Artificial Intelligent and Machine Learning provide Sense with the power to keep learning and understanding the information and interaction pattern. Sense can understand conversations and people's emotion by using sentiment and emotion analysis APIs. These new technologies offer vast possibilities for user experience design. As an important aspect, this thesis project aims to explore the possibilities and build integrated user experience using these technologies.

As the development of new technologies, they are going to be reached and adopted for more users, and the design of Sense will be fitted to different situations. Sense is expected to be applied to smart home platforms, social media platforms as a plug-in, and wearable devices to help people in more complex scenarios. I believe more and more systems like Sense will appear in the future that will benefit the whole society.
Links

Demos

Sense Demo https://vimeo.com/274586716
Shape and Pattern https://vimeo.com/274308513
Voice Recognition https://vimeo.com/274308587
Different Gestures https://vimeo.com/274310219
Create Gestures https://vimeo.com/274585621
Get more information https://vimeo.com/305005278
A Day with Sense https://vimeo.com/305005746

How does Sense know you are smiling? https://vimeo.com/297481770
How can you talk with Sense? https://vimeo.com/297482102

Useful links

Project Page https://designed.cad.rit.edu/project/sense

Author's Vimeo https://vimeo.com/zealaez
References


