Based on Action-Personality Data Mining, Research of Gamification Emission Reduction Mechanism and Intelligent Personalized Action Recommendation Model

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Abstract. To the emission reduction activities, use gamification design method to implant resonance and great meaning into mainstream residents' implicit goals, so that set up the personalized challenging ways to their goals and help them transit to more sustainable lifestyle. For making up a deficiency of the correlated "action A-B" recommendation model, this paper puts forward a new causal "action-personality" data-mining model, and finally establishes an intelligent personalized behavior recommended model to help residents to achieve the emission reduction goals.

Keywords: Emission reduction · Recommendation system · Gamification design · Incentive mechanism · Data mining · Motivation · Operation action · Resulting action · Sustainable development

1 Introduction

Mr. Nicolas Hulot, the global environment ambassador appointed by French President Hollande said that, "Promoting low-carbo n economy and reducing greenhouse gas emission are not burdens to everyone pushing each other, but to make a responsible decision around the world in order to ensure the sustainability of the Earth civilization" [1].

This passage leads to the first question: Why have people still regarded promoting low-carbon economy and reducing greenhouse gas emission as burdens, but not for interest?

The second question: Currently, 30 % CO_2 emissions were caused by the residents' living behavior and their economic activities. Although residents' reduction goals are consistent, their motivation and ability are vastly different. How can we recommend personalized reduction behavior to each resident, according to his own situation, so that he will complete the reducing emission task happily?

2   Goal

Looking for an on-going excitation mechanism lead residents to change. Including: active mainstream residents by human's resonance value; ignite them powerful motivations to participate in sustainable reduction activities; active mainstream residents by personality value; guide the different residents, participate in different emission reduction activities in different ways.

3   Roadmap Leading to Goal

- Analysis of the relationship between "Goal - Action - Personality";
- Analysis of the relationship between "Gamification Design" and the "Goal - Action - Personality" of the emission reduction activities;
- Analysis of the relationship between "The Internet of Things", "Big Data", and the "Goal - Action - Personality" of the emission reduction activities;
- Based on data mining, propose an intelligent model to identify resident's personality through "operation action"; and combines this one with behavior recommendation model to establish a personalized behavior recommendation.

4   Mainstream Residents Lack Goals and Actions Involved in Sustainable Development Activities

Cario Vezzoli, Ezio Manzini noted that the past 50 years, mankind has always faced the possibility of self-destruction. Fortunately, it has been realized that human beings are living in an unpredictable state. The root causes of human self-destruction are their ways of life. People have always regarded possession of material as happiness, so that a lot of products and consumer goods have been emerged. We also regarded modern machinery as slaves to work for us, so that we could enjoy easier life. People have used to the standard of happiness, which are reducing the strength, hours of work, or even the ability [1].

Therefore, the goals and actions of the mainstream residents in their daily lives are lack of the spirit of sustainable development. We need to guide the residents to change their goals and behavior, build up a new standard of happiness, "participation in sustainable activities".

5   Analysis of the Relationship Between "Goal - Action - Personalities"

5.1   Freud's Personality Structure Give Us Inspiration

Freud believed that personality structure is composed of three parts: id, ego and superego. "id" is the original me, refers to the original oneself, including the basic desire, impulse and vitality to survive; "ego", is to realize the implementation of

thinking, feeling, judgment or memory part; "superego," is representing the ideal part of the personality structure, is formed through internalization of moral norms, social and cultural value when the individual growing up.

Id, ego and superego, each of these three has its own goal. When the three goals are in a state of balance, individual will be in a comfortable state. Earth's ecological crisis, warns that people must change the values, from the happiness of "owning material", to "participation in sustainable development" as their new standard of happiness. This is not just the value transformation. In addition to changing the "superego", but also rebuild a new id, ego, superego balance system of the three goals. Although it's difficult to earth residents, we must change.

This paper will explore an incentive mechanism to guide mainstream residents to sustainable development-oriented transformation. Including three parts: goals, action, and personality.

5.2   Goal System

- Explicit goal: it refers specifically target determined in accordance with external influences.
- Implicit goal: it refers to an abstract goal driven by some intrinsic motivation [2].

5.3   Action System

About the behavior system, the paper cites the Jess Schell's classification. Action is the external activity driven by the explicit goal and the implicit goal. Such as: make a movement, make a noise. We can define resident's action from two angles.

- Operation Action: these actions refer to the basic actions to complete the task [2]. Although everyone uses the similar operation action when complete the same task, the details of operation action (such as rhythm, duration, frequency etc.) will be different because of the different implicit goal.
- Resulting Action: these actions are combined with a series of operation actions based on the strategic need. They are strategic actions of the residents in order to realize the goal, but not part of the task rules. Resulting action list is much longer than operation action [2]. The score, medal, ranking and other encouragements can represent the performance of resulting action.

5.4   The Relationship Between Personality, Goal and Action

Personality refers to a person's total psychological characteristic, which is relatively stable, with a certain tendency, influences his whole behavior and psychological characteristic to make difference with others. It includes: temperament, character, motivation, interest and ideal. Personality is the sustained, stable, consistent

performance in different situations, can be used to describe the differences between people. Decoding one's personality will help to explain his implicit goal and preference motivation.

The goal will cause people's action, and personality makes different people choose different action to achieve goal.

A task has not only a final goal, but also a series of midway targets leading to it. People with different personalities will complete the same final task through different behavior paths to realize it. We need to describe all the sub goals one by one, and to understand how they are related.

Jesse Schell pointed out: good goal has 3 important features: specific, achievable, with a reward [2]. Of course, people with different personalities choose different actions (operation action and resulting action) to achieve the goal, and yearn different rewards.

6 Gamification Design Stimulates Resident's Instinct and a Sense of Mission

The real question is that, for the mainstream residents who used to enjoying material comforts, emission reduction means giving up some interests, so these tasks are not resident's preferred goals. In other words, people are in the Freud's ego state, more care about the interests of the pros and cons.

How to make people willing to complete the task of reducing emissions as an important implicit goal? How to make them meet the passion, overcome obstacles to achieve the goal? How to make this transition process sustainable? Introducing systematic game elements, exploring the potential of "id" and "superego", these problems will be solved.

6.1 From the Resonance and Great Mission, Promote Reduction Activities Top-to-Down

Jane McGonigal pointed out that compared with the game, the reality is negligible. Game makes us plunge into more ambitious undertakings, and bring us great significance [3].

So, what is the game? According to Jess Schell's definition: game is a fun activity to solve problem [2].

Why does game should create resonance and great meaning?

Jess Schell noted that resonance and great meaning is always based on truth. It passes a core experience clearly. When this experience resonates with one of the resident's fantasy or desire, it will quickly become an important experience for him. Think of "Titanic", why is it so moving? It has a resonant and great meaning: "love is more important than life, more powerful than death" [2].

Jane McGonigal said the meaning is that all of us desire for getting more stuff: more methods to create the miracles, more opportunities to leave our marks on this world, more curious and respectful moments in our own community or project [3].

We combine above view with Phil Rarden's view of the goal value, and then raise one question: can we keep resident's explicit goal (emission reduction goal) unchanged, but slightly shift his implicit goal (part of superego)? Let reduction goal equivalent to the sacred mission, saving the Earth.

According to Jane McGonagal's perspective, as long as we implant a great meaning into resident's implicit goal through game, and then put the challenge into a larger social context to make every reduction activities more meaningful, so that the resident will participate the real reduction activities happily in order to complete his great virtual mission. Driven by the implicit goal (superego), guide the mainstream residents develop emission reduction habits and awareness gradually.

6.2   With the More and More Difficult Challenges, the Resident Will Gain Higher and Higher Abilities and More and More Flow Experiences Constantly, and Go Straight to the Final Goal

As implanting the great meaning into resident's implicit goal (the superego part), can we also implant motivation such as "adventure" into his implicit goal (the id part) to replace the original one "pleasure", so that change his behavior?

The game activity will stimulate the flow, so that achieve this goal.

6.3   The Gamification Reduction Activities Based on Service Process, Implement of More Feedbacks to Guide the Happiness Transition

Fortunately, with the popularity of the IOT and sensors, GDC2011 proposed gamification concept. Deterding, Dixon, Khaled and Nacke define the gamification as "the use of game design elements in non-gaming background." More and more practice prove that, gamification can effectively improve the production efficiency; it also can improve the efficiency of sustainable development activities.

In this paper, the research direction is sustainable oriented gamification design. The "non game background" is defined as sustainable oriented service scene, that is: add game elements on service design, and discuss the establishment of sustainable development-oriented gamification enabling system, guiding the mainstream residents to change. Jane McGonigal pointed out, that gamification makes our life and work into team adventures through adding unnecessary but challenging obstacles to existing living/working scene and giving players more incentive feedbacks [3].

So, the enabling system combined with service design and gamification design is powerful. To the mainstream residents, service design provides tools involved in the sustainable development activities, and gamification design gives great significance and happiness for action. Combining these two is the way to guide happiness transformation.

7   Analysis of the Relationship Between the IOT, Big Data and Emission Reduction "Goal-Action-Personality"

7.1   Quantify Emission Reduction Standards and Eco-Efficiency Goals

7.1.1   Quantify Emission Reduction Standards

In our work and life, carbon emission tough points are everywhere. As long as these tough points can be detected by sensor, they could be designed by gamification. Many experts calculate amount of details of carbon emission. These data are useful for gamification design. Such as the following: *1 kWh of electricity = 0.904 kg CO_2, 1 ton of water = 0.194 kg CO_2* etc.

7.1.2   Quantify Eco-Efficiency Goals

According to EU-funded sustainable design orientation (SDO) toolkit, we design a radar chart of environmentally sustainable eco-efficiency: Optimize the system life cycle; Reduce transportation/distribution; Reduce resource consumption; Reduce exhaust emissions/emission and waste recycling; Improved renewable/biocompatibility; Non-toxic, non-hazardous [1].

We can build a radar map to check sustainable eco-efficiency for each resident.

The system will build a model to transform the resident's reduction action to eco-efficiency assessment, and encourage him to participate in emission reduction activities continually through game score, medal and ranking.

7.2   Transparent and Accurate Measurement of Action

Today's IOT technology can accurately measure the resident's operation actions and resulting actions. Through detecting the resident's actions of the gamification touch points, such as force information, location information, body position, orientation information and time sequence parameters, etc., it can be derived his response time, support time, flight time, the action of the track, supporting force, moving distance, and related kinematic and kinetic parameters moving direction, speed and stride frequency and so on. Of course, the value of the data does not come from a single data, but out of the summary. All of these data will be gathered to the cloud, analyzed via big data to feedback the results [5].

7.3   Embodied Cognition: Recognize the Personality Through Operation Actions

Phil Barden pointed, "embodied cognition," thinks that the body level shapes all aspects of cognition. Every kind of feeling, body posture or state, even the body interaction with the environment, will all affect people's cognition. That is to say, not only the brain is able to think, but also the body does so [4].

As mentioned before, the sensor system of IOT has been able to measure various behavioral variables more and more accurately, this measurement technique can be popularized in large scale, and is transparent, no interference to the user experience.

However, the sensor can't cognize the meaning of the behavioral variables independently.

Fortunately, the human brain can understand the profound and subtle meaning of actions. This does not come from arbitrary, but has an objective basis, so there is consensus about the similar behavior representing the same meaning. Phil Barden pointed out that, as we grow up, the absorbed things by our brains are like statistical tables of our experience, which are our "environmental statistics". We use "tandem reflexing and simultaneous transmission" to learn things and build our associative memory. The entire learning process is hidden [4].

Scott Kaufman, scholar in Yale University, pointed out: the ability to identify our behavior patterns and rules in the environment is our fundamental cognition [4].

Based on experience, although the task decides operation action, the different operation actions will be tend to reflect one's stable personality. So the observer can use his brain's "environmental statistic" ability to find the corresponding relation between operation action and personality. How to combine the advantages of the human brain and machine to measure the meaning of the actions in large-scale will be discussed in Sect. 8.

7.4   Related Action-Based Recommendation System

How to do "private customized" gamification design?

At present, "guess you like", a recommendation system of online shopping is a good choice. Amazon invented it. The principle is simple: suppose when an user buys book A, the system will suggest you that most people choose book B at the same time, it guesses that you would also like to buy book B.

This recommendation based on the correlated action is also valuable in gamification enabling system, as long as replace "book" with "resulting action".

8   This Paper Proposes a Gamification Recommendation System Based on Correlated "Personality-Action"

There is a fatal defect of amazon "guess you like" recommendation model: it does not know the motivation of the resident.

"Guess you like" model emphasizes the relationship between things, but not care about causality; emphasizes the user-selected objectivity, but not subjectivity. "Guess you like" model cannot really impress resident's mind.

This paper will rebuild the "guess you like" model: binding the causation with the correlation to establish a gamification recommendation system, which may really impress the resident's implicit goal.

For example, it is assumed that when a resident takes A resulting action, the gamification recommendation system will tell you to take B resulting action, because the most majority residents with similar personalities do so (Fig. 1).
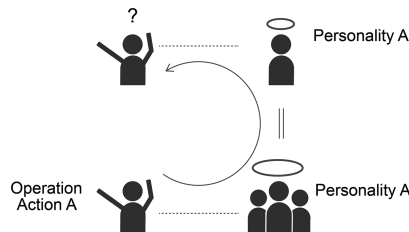
Fig. 1. Recommendation model base on correlated personality. Assuming a user takes resulting action A, the system will tell you that most people, with the similar personality, take action B after A, who buy goods A simultaneous buy goods B, it is recommended that you take resulting action B. (source: by author)
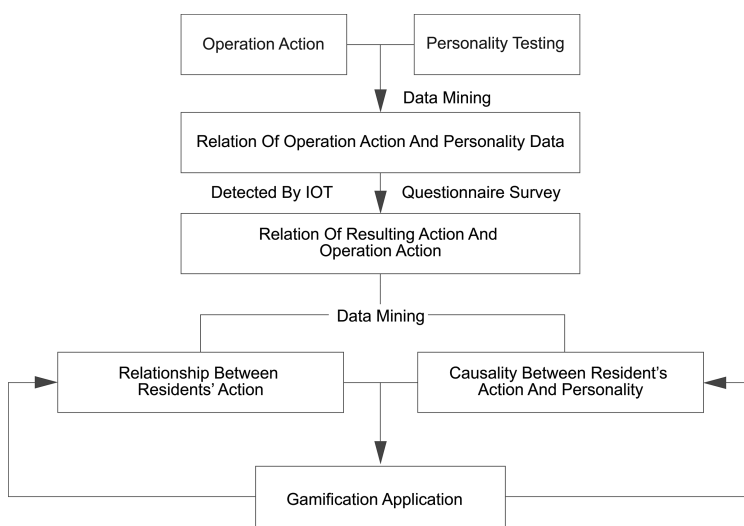

Fig. 2. The adaptive reduction action recommendation model based on the "personality – action" data mining techniques. (Source: by author)

How to make a machine to identify the human personality? Including 2 specific problems. How to build up a prototype of gamification recommendation system? How the prototype improve itself in operation. This is the solution (Figs. 2 and 3).

8.1   The First Stage: Build up the Prototype of Gamification Recommendation System

Purpose

- Build up simplified model to identify the "personality" from "operation action"(the key point);
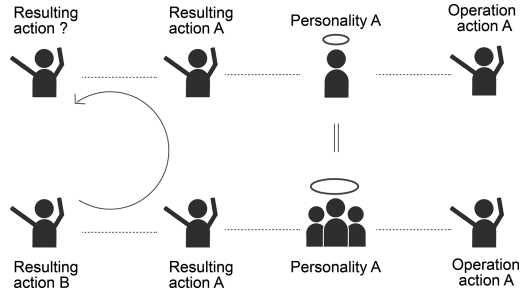
Fig. 3. The recommendation model combined with causality of "personality-action" and relationship of "resulting action A-B" (Source: by author)

- Build up model associated model the resident's existing "resulting action A" with recommended "resulting action B";
- Establish integrated model: both meet the causal relationship of "personality - operation action" and the relationship of "resulting action A-B", in order to recommend "resulting action B+"

8.2 Build up Simplified Model to Identify the "Personality" from "Operation Action" (the Key Point)

In Sect. 7.1.1, we get a result: machine sensor can finely measure people's action, but not understand the meaning of these behavioral data.

In Sect. 7.1.2, we get another result: people can recognize someone else's body language (embodied cognition) by the brain "environmental statistics", and to identify his personality. The result of "environmental statistics" is the establishment of correspondent relationship of "operation action– personality". This is a causal relationship between action and personality.

Our approach: let sensor capture different users' operation action data; build up simplified clustering relationship through data mining;insight the personality types behind these clusters; establish the initial "operation action– personality" data model; at the same time, through online surveys to investigate each resident's personality; validate and improve the "operation action – personality" data model.

- Select a number of sample residents to participate in the testing activities, assign an ID number for each one.
- Collect resident's reduction action data. Including: historical data of resident's emission reduction actions collected via IOT, real-time data of resident's operation actions collected via sensor.
- Using clustering algorithm tool to cluster the "operation action".
- For each resident cluster, tag personality label through a brain "environmental statistics" analysis.

- Through online personality survey tool to identify each resident's personality, and label them personality tags, such as: action party, adventure party, creation party etc.
- About personality investigation methods, there are many mature ways.
- By resident's ID number, integrate the "environmental statistics" results and the "questionnaire investigation" results, conclude a more precise "operation action – personality" data model.

8.3   Build up Model Associated Model the Resident's Existing "Resulting Action A" with Recommended "Resulting Action B"

Then, establish the relevance between existing "resulting action A" and recommended "resulting action B". That is whether the resident who participate in activity A will be interested in B?

- Design gamified emission reduction activities, including target, rules, feedback system, voluntary participation way, and various personalized task to the goal or sub goal.
- Each resulting action of the gamification activity is corresponding to a sub goal.
- Choose a group of sample resident to participate testing activity, tag each one an ID number.
- Organize them to participate in the gamification activities; there are different activities and goals for chosen.
- After the activity began, resident could choose any sub goal to achieve with his voluntary resulting actions. System will label each typical resulting action, prepared to recommend others.
- We are concerned that, when the resident actualize a resulting action, what is another action he interested? For example, does a resident have some interest to participate daily paper saving activity after the energy saving activity? If interested, how is the degree? Whether is it worth to recommend?
- The correlation algorithm tools of data mining can solve this problem. Through the analysis of relevance between different resulting actions, decide to recommend which one. These relations include: support, confidence, and lift.
- After a sufficient amount of data, according to these indexes to establish "resulting action A – B" data model. The data model is correlated with resident's ID number. This part of work is partially similar to Amazon's "guess you like" approach.

8.4   Establish Integrated Model: Both Meet the Causal Relationship of "Personality - Operation Action" and the Relationship of "Resulting Action A-B"

- Integrate "operation action – personality" data model and "resulting action A – B" data model through the resident's ID number to form a final recommendation,

which called "resulting action B+" in this paper. For example: a resident is interested in saving electricity. After analyzing "resulting action A – B" found he liked running also; after test of "operation action – personality", found his personality, outgoing and sociable; so the system recommended him to take part in running party activities (resulting action B +).

8.5 The Second Stage: Establish Operation Database of Adaptive Gamification Recommendation System

Operational database is perfected based on the prototype of recommendation system. In the practical application, automaticly identify resident's "personality type" and "resulting action", then recommend new "resulting action+", and self-improve the failure. Through this process, improve and expand seed database to form a more accurate operation database. It is suitable for the whole process from small database to large one.

- When the resident chooses and executes a gamification task, the system will track to measure his "operation action" and "resulting action" data.
- When the system collects some resident's "operation action" data, it will automatically find the corresponding his "personality" from the "operation action - personality" data model. To infer causal This part of the work belongs to speculating the causal relationship of "operation action" and "personality".
- When the system collects a resident's existing "resulting action A" data, it will automatically find "resulting action B" which is worthy to recommend form the "resulting action A – B" data model.
- The system automatically integrate the speculation of the causality and correlation, and recommends resident the final "resulting action B+"
- In this process, if one's "operation action" data is not corresponding to the "operation action - personality" data model, the system will add this data to redo the clustering analysis, update or add new "personality" label to make the system more perfect and accurate. This is the self-study process. With the processing from small data to big data, the "operation action – personality" data model will be more and more accurate.
- At the same time, "resulting action A – B" data model is a story making machine, more and more stories will be created by the residents participating the gamification activities. This process will attract more residents to join.
- Under the continually driven by the model of "operation action – personality" and "operation action A – B", I believe that more and more residents will participate the activities and transform from existing personality structure to higher one (id, ego, superego).

9   Conclusion

The earth is facing ecological crisis, humanity's survival way must change to sustainable development- oriented. But there are two questions.

The first question: the residents will not change their inherent habits only excited by the real goals (explicit goal).

The proposed solution A in this paper is: set up a gamification enabling system of goal incentive mechanism.

Using the gamification method to implant resonance and great meaning into resident's "superego" implicit and explicit goal, guide him improve his original implicit goal top to down; through gamification challenges inspire resident's "I" implicit goals, guide him improve his original implicit goal down to top. Residents realize the emission reduction goal ("ego" explicit goal) through participation to gamification activities (resulting action). In the process, easily change habits.

The second question: the behaviors, personalities and motivations of the residents are diversification. How to automatically adapt these diverse needs and recommend different residents their preferred reduction activities accurately?

The proposed solution B in this paper is: put forward an innovational adaptive reduction action recommendation model based on "operation action – personality" data mining technique. Combine this model with author's "resulting action A – B" model, to realize accurate "resulting action B+" recommendation through gamification goal-action-personality system.

Solution B, from the personalized value of each person induces people to change habits, transit to sustainable development smoothly.

How to motivate people's goals and actions change towards sustainable development? This paper proposes a complete system from theory, mechanism and intelligent solutions. This system is universally applicable for clothing, food, housing, transportation, travel, education and other aspects. It is expected that the system have a great role in promoting the transition towards sustainable development.

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