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Analysis Design Learning Agents ITVL with UCD and Face Recognition

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ABSTRACT

Usage of technology device is already in our everyday life, and with a corresponding software it helps everyone's daily life. Research in this paper is focused on the application of learning agent into one of a technology device, which is ITVL to learn user's response and emotion to given media with help from User-Centered Design method in development and Face Recognition for the learning process. Performance of this learning agent will be assessed based on knowledge of response and emotion from user to given media, which is result data from implementation Face Recognition. The aim of this system is user can enjoy and relax and because that reason, User Centered Design approach is used, ITVL as the system of SMART TV is having direct interaction with the user for learning and decide which program need to provide. This system needs to know exactly how human as a user of TV want and expect from the system. And the system must be developed in a way just be right how the user uses a TV, deciding TV programs or channel, time usage, user's behavior, and other aspects that can influence the learning process of the system. As for Face Recognition, this concept already been studied a lot and applications of face recognition have been used in any aspects we can see every day, even for games purposes. Face Recognition is a new way to interact and communicate with a smart system for improving ease of use. Furthermore, the product of this research believed can be useful information in development and implementation of artificial intelligence into technology device.

Keywords: *Technology Device, Learning Agent, User Centered Design, Face Recognition.*

1. INTRODUCTION

With rapid technology is growing, either from hardware or software aspect, the need of human and how to use technology also become varieties. Usage of technology was low because it is still a new thing and human's knowledge of them still low despite the need for basic knowledge in using technology. Nowadays technology expected to have become friendly-user and easy to learn, even there are some demands for technologies to know exactly what user wants, what user need, and what user expect from the technology. Technology also becomes tools to get information or send information, start from local network to internet which is a network on a global scale. Implementations of technology and information open a chance for new implementation for any purpose such as Intelligence TV Learning or ITVL which is the aim of this paper. This paper describes the aim of ITVL to learning about user's usage of media from any aspects included interest, hobby, and even user's like or dislike of things. With using User Centered Method, ITVL designed to focusing on the certain user and saving the data from the user such as emotion that shown by face, voice, or user's behavior. ITVL using Artificial Intelligence (AI) for its process of learning user. Agents can be described as "*software robots"* or
simply "*softbots"* because of the fact that robots are an agent with the artificial body. Agents have the ability to sensing and interacting their environments like a robot, but softbots act as a response to its environment is through virtual actions(Lorscheid, 2014). Intelligent Agent is an automated entity that observes using the sensor and performs its action in its environment using actuators and directs its activities toward the direction to achieve its goals. Intelligent Agents can also learn or use their knowledge to achieve goals Agents are divided into several classes: Simple Reflex Agents, Model-based Reflex Agents, Goal-based Agents, Utility-based Agents, and Learning Agents used in this study.

2. LITERATURE REVIEW

(Liang *et al.*, 2009)The author found a problem of demands that a teacher should be able to design their own subject matter and also provide direction so that the subjects taught can be related to the daily life of the students. Therefore, the authors conducted a study to design a resource system in accordance with the needs

and skills of teachers by applying user-centered design as an approach to create a relation between developers and end-users of the system, as well as expressing their own needs for developed systems.

(Vilarinho *et al.*, 2016) The authors conduct research on the problem of using fossil-based natural resources with its limited nature. Many parties are driven to find other alternative sources such as solar panels that are already a big step towards this problem. But the authors argue that the better and responsible nature of energy consumption can also be a good step for this problem. Therefore, the authors designed a software with the concept of user-centered design that aims to improve the sensitivity/concern of the user of energy consumption in a smart house.

(Bansal and Chawla, 2013)The author considers that the features and functions of facial recognition are valuable aspects especially in the field of investigation and forensics. This field has also been in great demand in the field of image processing in an academic way. But the challenge that comes now is how to improve the performance of face recognition, both from the aspect of accuracy, pose variation, and the ability to recognize in images with limited resolution. Author comparing two methods as the main topic that are face recognition performance using Principal Component Analysis (PCA) and Normalized Principal Component Analysis (N-PCA) in recognizing the face of a database that contains variability in terms of facial expression, face pose, and face detail.

(Azad *et al.*, 2014)The authors assume that the movement of the hands and the human face is the key to interaction with the smart system, even the introduction of these two patterns can be a new way to interact with systems such as computer games, virtual reality systems, as well as HCI systems. The author designed the system of recognition of these two patterns to control the media player on the computer. There are 4 steps that are made in the research. Those are (1) the introduction of hand and face movements, then (2) extraction the movement of the hand, after that (3) analyzing the location of the face which is then sent to the (4) recognition step where the conditions in the inspection and then the hand and face patterns recognized by the system. The result compared with data obtained/recognized based in the video from the American Sign Language (ASL) database.

(McLoone *et al.*, 2010)In his research on UCD, the author gives illustrations of problems encountered such as when we will record a favorite movie but encountered obstacles because do not know how to set automatically for VCR record. Therefore, UCD aims to make users participate in the design of software or system prototype. The important point that is emphasized is that the user contributes well in any way because the user will be the user and the consumer of the developed system.

3. THEORETICAL BASIS

3.1 Learning Agent

The principle of this agent is to make it an agent who 'want' to learn and collect as young as data that can help the learning process. Data that is then processed into knowledge will help this agent in achieving its goals better over time. The most important part of this agent is between "Learning Element" responsible for making improvements, and "Performance Elements" responsible for selecting external actions. (Wikipedia, n.d.) As for learning process, we adopt a method called 'Reinforcement Learning' from (Systems, Labora- and Technology, 2008). As a part of its definition that we adopt is 'Reinforcement Learning is an online, incremental learning technology, by which intelligent agents interact with surrounding by trial-and-error'. To learn about an individual face, emotion, and behavior, the agent needs so much trial and result for its knowledge and make a better decision in the future.

3.2 User-Centered Design

The notion of UCD is that UCD is a term for philosophy and a method that focuses on designing to engage users in the process of computerized system design(McLoone *et al.*, 2010). The UCD learning that is applied to an artificial intelligence will make it consider a user as a large book with complex reading content. Living depends on what part of the user is learned and by what means an artificial intelligence will learn it.

3.3 User in UCD

To engage users in designing a computerized system that has artificial intelligence, we first need to know what data we need from a user to become knowledgeable, and how to get it. In a technological environment with artificial intelligence, there are many kinds of users who either use or those around users in that environment. Quoted from (McLoone *et al.*, 2010) Eason (1987) identify that there are 3 types of users, namely: Primary, Secondary, and Tertiary. Primary users are those who use the technology; Secondary is the user who uses the technology indirectly; Tertiary is the user affected by the use of the technology.

3.4 System Design UCD

The stages in designing a system with UCD should be full of calculations cannot be direct to complete (all in once), because the end product will learn and focus on the user, it must be tested in advance in the prototype stage to test and ensure its use at scale a long time later. Measurable usage criteria are about issues related to effectiveness, safety, utility, learning ability, and the ability to

remember from a product and also user satisfaction subjectively (McLoone *et al.*, 2010).
Quoted from (Vredenburg *et al.*, 2002) following factors in measurements for UCD effectiveness.

Table 1: Factor Measurements for UCD effectiveness

Measures	Frequency
External (customer) satisfaction	33
Enhanced ease of use	20
No useful response	20
Impact on Sales	19
Reduced helpdesk calls	18
Pre-release user testing/feedback	16
External (customer) critical feedback	15
No UCD measures in place	15
Error/success rate in user testing	14
Users' ability to complete required tasks	10
Internal (company) critical feedback	6
Savings in development time/costs	5

3.5 Face Recognition

Face Recognitions or Face Detection is not a new thing since it already an active area of study in computer vision for more than 20 years(Paschalakis and Bober, 2004). Automated face analysis that includes face detection, facial recognition, and recognition of expression has become one of the most studied topics. An important key in the facial analysis is finding an efficient description of facial appearance (Ahonen, Hadid and Pietikainen, 2006). The use of Face Recognition application is indirectly divided into 2 categories, namely common applications we know like Google Image Search, Google Picasa, or other applications related to face recognition but not too complex. And there are also applications that require face recognition at the most detailed and complex levels for security such as in office buildings, banks, malls, campuses, and housing. There is also for sensitive machines like bank machines and automatic vending machine. Compared to other introductions such as fingerprint or iris, face recognition has the potential to work with less controlled test data, allowing the system less intrusive to the user of the system (Wagner, Member and Wright, no date)

3.6 Knowledge Representation

Knowledge is a key factor and the main resource for an artificial intelligence. That is why an artificial intelligence need a knowledge representation method.(Garrido, 2010) Things that an artificial intelligence needs to represent are categories, objects, properties, relations between objects, situations, states, time, events, causes and effects, knowledge, about knowledge, and so on.

4. RESEARCH DETAIL

4.1 ITVL

Speaking of technology, we are talking about the future. And the future includes science, intelligence, and artificial intelligence (AI). However, AI can be made more have a 'mind' and 'human nature' for a particular purpose. Here we create an AI for television with a 'sense' to gain knowledge of existing data which is user, and 'human nature' which aims to assuming that user's favorite media, schedule, mood, and behavior are important data. Intellect and human nature are combined in decision making so that users feel that ITVL is like someone who helps and serves in terms of enjoying the media on television.

4.2 ITVL's User

In this paper research, the user of the ITVL system is a user who enjoys television and media in it, such as live events, VOD (Video on Demand), streaming video, playing songs, and others. These media will be a source of data for ITVL for knowledge of the media that is decided to be displayed automatically by the user, if manually then the user himself who determines the media to be aired. ITVL users are expected to be able to enjoy these media as comfortable as possible and can interact with ITVL.

4.3 Input and Output of ITVL

As already mentioned, the convenience aspects, habits, moods, selected events, favorite events, schedules and responses from users will be data for ITVL. The data comes from the user's face image captured by the video camera and then extracted based on the user's face pattern points on the image. For example, input if the user has several times watching basketball event then it can be decided by AI as a user favorite event in the system without face recognition. So the AI output will look for the upcoming basketball match data both in detail and in detail (e.g. only matches by a particular team). That way AI is ready to show or suggest the game to the user (output). When displaying the media, the system is ready to receive input from the user when the user shows a bored face when watching AI will record the data and learn the behavior of users that are not so interested anymore with the basketball game. Events that are selected by user later will also be an information and knowledge for the ITVL system to be a recommendation if similar things happen again.

4.4 ITVL Face Recognition

As we can see in Figure 1, in this research, we apply the UCD as a method for developing AI system and Face Recognition methods as discussed in the previous chapter.

To get the image as a data to be recognized, this design uses a video camera with a good enough resolution so that the system can recognize the user's face. There are several stages designed in this system, first is the pattern recognition using dots that have been designed to mark each part of the face. Then the position and condition of each part of the face will be the face pattern recognition data which will then proceed to the stage of face recognition. At the facial recognition stage, the system will respond instantly by comparing the extracted data obtained with the dataset owned, then make the data knowledge of the user and proceed to the last step is the action to make learning and decision making will the user. In Figure 1 can be seen that ITVL process in recognizing the face of the user, the user's face data is the determinant aspect for the system for what media will be shown automatically to the user.

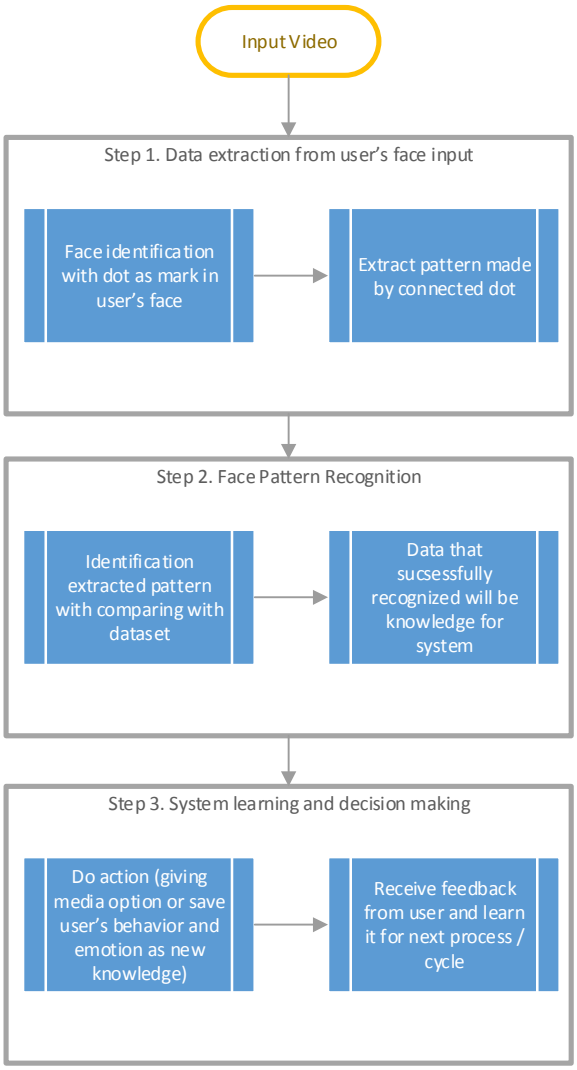

Fig. 1. ITVL Face Recognition Process

4.5 AI Scenario with Media on Television and Internet

Figures 2 shows that ITVL system will continue to process the input of user's emotion and comfort to the television media that is aired. In Figure 2 also shown that besides face recognition to learn emotion of user, ITVL system also continues to learn about available media and user favorite events stored in a dataset. When a television show is aired, the system will always respond to user responses such as emotion and user comfort shown through the face, this is what triggers the system to look for other programs or movie and choose it as optional for the user.

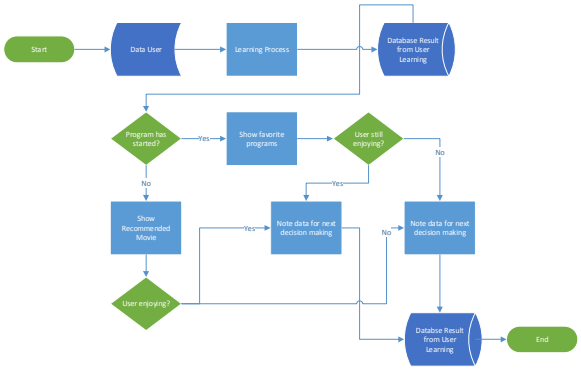

Fig. 2. Scenario with Media on Television

Figure 3 describing the same process like Figure 2, but the only difference is media to be shown to the user is from the internet (e.g. like Youtube, Twitch, Spotify, etc). This makes ITVL have more option to choose for entertain user but also make ITVL have to be more 'smart' in filtering options with 'tags' such as genre, duration, age-restriction, and etc.

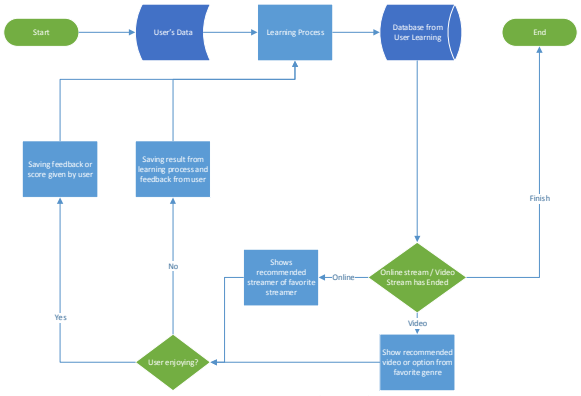

Fig. 3. Scenario with Media on Internet

4.6 Knowledge Representation

For ITVL, two method of knowledge representation is chosen. There are script and semantic network. For script, we can see Table 2 for example.

Aim	Emotion detection
Role	User
Support	TV, Camera, Remote
Input condition	Search for tv program
Act 1	Turn on TV
	User take tv remote
	User press on power on tv remote
Act 2	Watching tv
	User choosing channel
	User enjoying chosen tv program
	AI read user's face through camera
	AI detect user's expression while watching TV
Act 3	Shutdown TV
	User take remote TV
	User pressed button on remote TV
Result	-User expression while watching TV -AI make a recommendation program for user

Table 2: Script Knowledge Representation

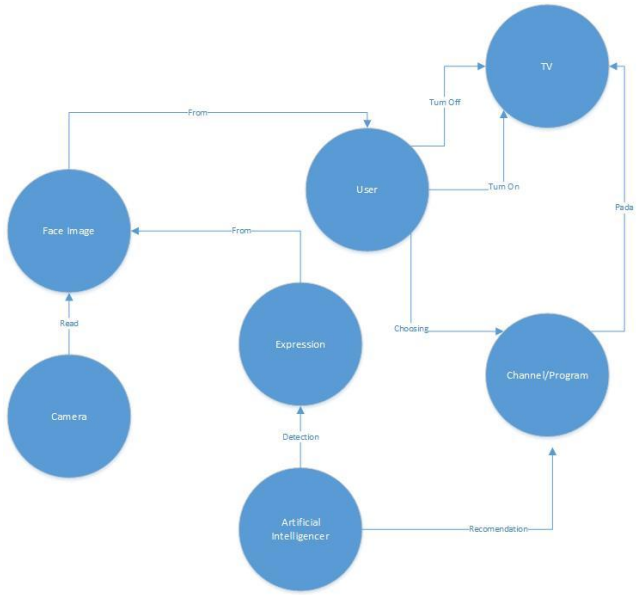

Fig. 4. ITVL Semantic Network

Semantic Process:
(Tomescu, 2015)For gathering around a specific object for explaining, locating, and make process of retrieve in a catalog or collection be easier.
We can see process of ITVL's semantic network in Figure 4. The reason for choosing script is to see the order of process or event in face recognition process, while semantic is to watch the relationship from many object that captured as image graphic in face recognition process.

5. RESULT AND CONCLUSION

ITVL PEAS (Performance, Environments, Actuator, Sensor)

Performance Measure	Accurate channel timetable reminders, suggesting appropriate media and comfortable user enjoy.
Environments	Small watching room for approx. 2 users
Actuator	Display (Display), Speaker (Media), Speaker (Interactive).
Sensor	Camera, Microphone, Display (Touchscreen), Remote Input Receiver

ITVL's Learning Agent Characteristic
Here's an explanation of the discussion agent from ITVL:

- FULLY: The only observer in the user and the search for media sources is certain.
- DETERMINISTIC: Selection of appropriate media will be based on certain criteria gradually.
- SEQUENTIAL: The solution will be used again because the user not only enjoys the TV once.
- SEMI: Search decisions (media) can fit the user's schedule (static) or favorite or user's comfort (dynamic).
- CONTINUOUS: Media search parameters of more than 1. For example, availability / genre / favorites / others.
- MULTI: Agent to monitor the user's comfort level, and the agent in charge of selecting the channel/media for the use.

Category	Elements
Knowledge Representation	Action, Condition-Action Rule
Agent Preferences	User satisfication level
Reasoning	Conscious
Exploration Strategies	Systematic experimentation
Experience Collection	Experience by Observation
Payoff	Performance Measure and User Satisfaction

6. FUTURE WORKS

ITVL uses Face Recognition and User-Centered Design methods to monitor and collect data from a complex human user, so ITVL is still limited in the appropriate environment and supports such an apartment, and can only monitor 1 (one) user for effective results, it also takes a long time for continuous AI learning of users for accurate results. Further development and study are needed to apply to large-scale users or in crowded environments. Nevertheless, it is hoped that the results of this study with this literature study can be useful for the development of AI either in the scope of Learning Agent or AI as a whole.

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