Impartment of Japanese Farming into Vietnam Remotely with IoT Considering Motivation of Farmers

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Abstract. In Vietnam, high percent of population are doing farming. However, their crops are very low quality. The paper proposes a model to impart excellent farming technique of experienced Japanese farmers to Vietnamese farmers to improve the crop quality and sustain the environment. We will make a farming manual considering important factors internally and externally motivate Vietnamese farmers with the facilitation of IoT. These factors are motivation factors. IoT devices such as sensor network and eye cameras are facilitated on the Vietnamese farmers and the farm field. Many kind of farming data and non-farming data express behaviors of farmers. From these data, we use non-negative matrix factorization to transform the behaviors into motivations. The motivations are included into the manual.

Keywords: IoT, motivation, behavior, evangelist, agriculture impartment.

1 Introduction

Most of farmers in Vietnam lack of knowledge and information safe and sustainable agriculture. They use excessively chemical fertilizers, chemical insecticides for their crops. Their crops are low quality. The farm field and environment get more and more polluted. On the other hand, most of Japanese farmers have advanced skill and experiences. They produce very high quality products. But, due to aging and harsh work, many private farmers give up farming. That makes it difficult to sustain the skillfulness and great experience of the Japanese elderly farmers.

It is very beneficial to impart the Japanese farming technique of the skilled farmers into Vietnam. The impartment will lead to significant benefits for both of the two sides. Vietnamese farmers can produce high quality crops sustainably, improve environment and their lives. It also contributes to stabilization of food supply for Japan and overseas expansion of Japanese food including cultivation law.

For the impartment, it is desirable that the skilled Japanese farmers go to stay in Vietnam and instruct Vietnamese farmers in a long term. However, it is infeasible for the Japanese elderly farmers to stay far from home due to health condition limit. It is also difficult for Vietnamese farmers to stay in Japan to obtain farming knowledge due to low income. If skilled Japanese farmers can teach Vietnamese farmers remotely, they can teach high quality crop cultivation methods with a small environmental burden.

Existing researches for formalizing tacit knowledge of skilled farmers does not take human psychological factors into consideration [1,2,3]. Not limited to agricultural technology, motivation and self-regulation are important factors for efficient technology acquisition [4,5,6,7]. In our case we will solve the question of what are important factors that motivate Vietnamese farmers to work in agriculture. There are factors externally motivates the farmer

such as money, praise, self-respectation, etc. There are also many factors internally motivate the farmers, such as farming enjoyment, farming knowledge, farming-challenging ability, etc. We call both of external factors and external factor motivation factors in general.

We succeeded in identifying motivation factors in Japanese students in programming learning [6,7]. We also succeeded in designing manuals for setting programming courses to improve student motivation to learn in Japan [8]. Nevertheless, there is no case of applying to farmers who have different cultural backgrounds including language, farming work experience, and work values.

Since agriculture is opposed to nature, unpredictable disturbances can occur such as weather, insect damage, diseases. In order to prevent and reduce the disturbance, systems with IoT has been advanced for automation at many plant factories. However, in plant factories, hydroponic cultivation, which is easy to control, is the focus and crop types are limited. With diverse crops naturally grown by farmers under the sun, it is impossible to maintain the current food culture. It is necessary to teach the young farmers the skill to cultivate various kinds of crops with high quality sustainably.

We aim to establish the environment to remotely impart the technologies of Japanese farmers to Vietnamese farmers. It focuses to achieve the followings:

① make a manual of agricultural techniques of Japanese farmers. It includes farming videos, pictures, key points, etc., of the whole cycle to produce a crop.

② automatically detect Vietnamese farmers' work on guidance of Japanese farmers with IoT technology, such as sensors network, eye camera.

③ identify motivation of Vietnamese farmers by machine learning such as NMF [9]. Data taken with IoT hold faming behaviors of farmers. MNF will transform the behavior data into motivation data.

(4) utilize the evangelists who can understand Japanese language and Japanese farming technique. The evangelists explain the manual to Vietnamese farmers.

⑤ improve the manual of ① with motivation factors of Vietnamese farmers for evangelist and Vietnamese farmers.

This is an epoch-making study that analyzes psychological factors such as motivation and self-regulation of farmers that have not been studied so far with IoT technology. Also, by utilizing new key person named evangelists, it make the agricultural guidance environment between the two countries become feasible and promising.

2 Data expressing the interests of agriculture

2.1 Japanese vs. Vietnamese cultivation

Japanese skilled farmers have advanced knowledge and skills. Moderate tasks on agricultural crops, such as refraining irrigation at a specific growth stage, has an effect on growth promotion and strong resistance against diseases. Japanese farmers producing rice care for drainage of their rice field very carefully before the rice being in the ear. They drainage to the field until it chaps as the figure 1 shows. When the field chaps at that degree, oxygen will go through the soil. The roots of the rice would get stronger because they try to take water for the rice tree. After 1 week of severe drainage, the farmer let the water and fertilizer in the field. With the farming technique

and instructions provided by the local government, they make best effort to achieve the highest quality crops.

On the other hand, Vietnamese farmers get accustomed to easy-going farming way [10,11]. They may ignore the carefulness to the field, take it not serious to examine the field condition frequently. They do not prepare well the field soil. They look down the prevention of disease pest coming. When the disease pest comes, they rely on chemical insecticides [11]. Vietnamese farming to produce rice does not include the step of letting the field chap.

Figure 1. Careful Japanese farming technique

In order to impart Japanese technique to produce rice to Vietnamese farmers, we need a technical manual with visual explanation. And, the most important one is the encouragement for the Vietnamese to change their easy-going farming way to serious Japanese farming method. We have to know their motivations toward farming and toward lives to encourage them properly. For example, a farmer does the farm because he wants to have good crops for his own family and money to support family from selling the rest in excess. However, he does not have enough knowledge of cultivation of the crops. He has to do the farming but he does not feel enjoyable with it. The manual should clarify the cultivation methods to him. In addition, it should emphasize the external factors, good crops and money, to motivate him.

2.2 Farming motivation

R. E. Slavin [4] says that "motivation is internal process that activates guides and maintains behavior over time". A strong motivation to do farming would be a determining factor leading to the success. Together with motivation, effective farming strategies are as important as the motivation to reach to achievements. MSLQ [5] is a good guideline to make questionnaires to understand components of motivation and farming strategies of a farmers. MSLQ not only provides descriptions of each component, but also enumerates sample questions.

For motivation, MSLQ lists up intrinsic, extrinsic, task value, expectancy, and affective components. Farmers who have intrinsic components participate in target tasks because their goals are achievement of the tasks. They work because of reasons such as their challenge, enjoyment, curiosity, and mastery. Farmers depending on extrinsic components participate in tasks because a farming task is the means to their goals. Components such as rewards, money, and competition make them engage in the tasks. Task value components are determined by the perceptions of the tasks in terms of interest, importance, and utility. Expectancy components refer to the beliefs that their efforts will results in good outcomes. Affective components are related to anxiety for competition. For example, since they worry about competition, they make efforts.

A farming strategy is a personal approach to understand the farming problems and solve them. Framing strategies consists of resource management strategies and self-regulation strategies. The resource management relates to the ability to understand the usefulness and effectiveness of given resources for the farming. As for resource management, MSLQ enumerates study environment strategies regarding to setting of cooperation and information-sharing places, and help seeking strategies to get supports from others including peers and instructors. Self-regulation strategies work in the process whereby farmers systematically direct their thoughts, feelings, and actions toward the attainment of their goals.

2.3 Farming behavior and IoT

Motivation is inside factors of farmer motivating him to do the farming. They cannot be seen. We have to rely on behaviors to estimate motivation. We should conduct contextual inquiry [11] on farmers to know their behaviors and their implication of relation of motivation factors with behavior factors.

With contextual inquiry, the interviewers, farmers, delve into the details of the talk of each other until they grasp the whole image of the work of each other. They write down the scenario described the other`s work reflecting all the facts obtained in the interview. From the scenarios of many farmers, we will find common behaviors factors and motivation factors of the farmers.

With IoT facilitation, we can obtain farming data representing behavior factors in quantitative. For example, with RFID tags and tag readers, we know how many times a farmer goes to the farm field, and how much time he spends on the farm. With sensors for field data, we can get the carefulness degree of the farmer toward a task, such as ploughing the soil.

Farming behaviors and motivations sometimes can be inferred from not-farming activities. IoT nowadays can support living in many fashion such as healthcare, playing, child assist, gardening assist, etc [16]. The behavior data from these activity can contribute to understand the farmer motivation.

3 Impartment of Japanese agriculture technique to Vietnam based on motivation of farmers using evangelist and IoT

3.1 Impartment model

We will establish the environment as shown in figure 2 to make the remotely teaching the technologies of Japanese individually to Vietnamese farmers. We concern the matters of different language and motivations toward the farming to achieve the work.

As we stated, the manual would have two parts. One part is the farming technique. It includes videos, explanation, etc. of fine-grained Japanese farming methods for a crops at the first step. This manual will be improved until it can represent fine-grained Vietnamese farming methods. The other part is the inclusion of motivation factors in to the manual to encourage the farmers to follow the manual for their crops.

We will find the motivation factors with machine learning methods, such as NMF. Our system will analyze the motivation factors during the farming process of Vietnamese farmers and how faithful they are to follow the instructions from Japanese side. The input data are taken with IoT facilitated on the farm field and farmers.

Next, we will foster the evangelists who help to solve the problem of the difference in language. At the current time, many highly-educated Vietnamese people have learned Japanese for employment in a Japanese company as well as agriculture. We invite them

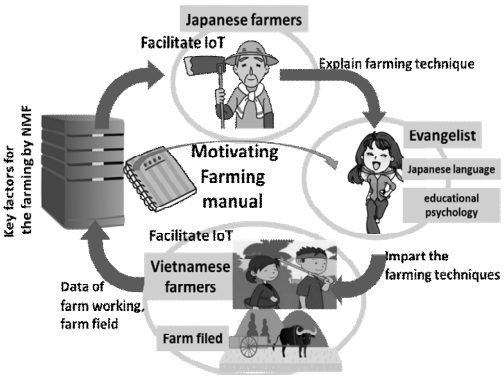

Figure 2. Impart Japanese farming techniques to Vietnamese with IoT

to work as evangelists. The Vietnamese evangelist will stay in Japan for several months and study the foundation and terms of agriculture with Japanese farmers.

3.2 Identification of motivation factors

Motivational factors include many factors. Intrinsic factors express the learning and doing farming itself is pleasant. Extrinsic factors concerns the expectation of compensation such as money. Affective factors represent to feel trying to avoid punishment. Self-regulation such as resource management exploits resources such as time, and meta-recognition expresses the ability to think about the significance of work.

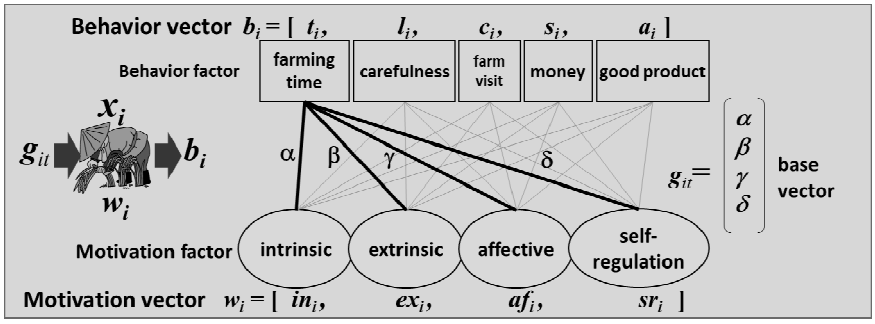

Figure 3. Each behavior factor is the visual result from many motivation factors

The motivation factors can be estimated. For example, extrinsic factors can be estimated from the work after premiums or money are raised. Affective factors can be estimated from work before the preliminary announced field test. In this research, using the machine learning method, non-negative matrix factorization (NMF), based on the method described the papers [5,6,7,8,12], we can calculate the strength of each factor of each farmer. In this method, it is assumed that a behavior, e.g. farming time t_i, of a farmer *i,* who has certain motivation factors such as intrinsic, extrinsic, affective, and self-regulation, is a total weighted effect of the motivation factors, as described in figure 3. Farming time t_i can be expressed with:

$$t_i = [in_i, ex_i, \alpha f_i, sr_i].[\alpha, \beta, \gamma, \delta]^T = w_i . g_{i_t}{}^T \quad (1)$$

where w_i is motivation factor vector and $g_{i_t}{}^T$ is gene vector of the farming time behavior.

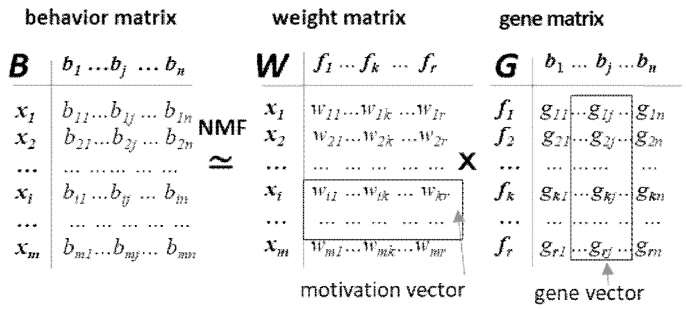

Figure 4. MNF to transform behavior factors into motivation factors of farmers

Similarly, other behaviors are expressed by the inner product of the motivation factor vector and the gene vector of the behavior. The gene is assumed to be independent of farmer, but dependent on common condition of the farmer such as economic condition, weather condition, etc. Under this constraint, each of the n kinds of behavior of m people is represented by an inner

product of two matrices so that the error is minimized by a numerical approximation method of NMF in figure 4:

$$B_{mn} \approx W_{mr}.G_{rn}$$

where B_{mn} represents n behavior factors of m farmers, W_{mr} represents motivation vectors of the m farmers, and G_{rn} consists of vectors showing the effect of motivation the factors to every behavior factor.

After the approximation, we will achieve W matrix, which shows the motivation factor vector of each farmer. Once we now the strength of each motivation factor of a farmer, we can model the farming manual according to the motivation characteristics. The evangelist will use the manual to achieve the impartation work.

3.3 Automatic detection of agricultural behaviors by IoT

Japanese farmer need data of farming condition, including data of the field such as the pH, the dryness, nutrition component of the soil to give proper instructions to Vietnamese farmers. We also want to know how faithful the Vietnamese farmer is, to the guidance of the Japanese farmers as it represents the motivation of Vietnamese farmers. We set sensors to measure soil environment in Vietnam field with devices in figure 5, eye camera to take video of the farm and acceleration sensors to identify farming work.

We need to obtain data representing behavior factors of every Vietnamese farmers. We also need data for the initialization of the two result matrices for the NMF. Depending on the behavior factors which understood by the contextual inquiry, we will examine the data taken by IoT [13]. With eye cameras, we can have data for behavior factors to make behavior matrix, such as the amount of faming work and the time spending on farming work of every Vietnamese farmers [14].

Figure 5. IoT for farming data

We will use contextual inquiry data for the initialization of the gene matrix. To initialize the weight matrix, we combine contextual inquiry with behaviors of each farmers taken by IoT. For example, since Vietnamese people emphasize the time spent with their families rather than the outcome of their work, it may be necessary to measure not only the work situation but also the time spent with their families. We can facilitate wearable wireless acceleration sensors for Vietnamese farmers [15].

The Vietnamese farmers who are the subjects are asked about the purpose, method, period of the research, the place, the possible dangers and benefits, what kind of consideration is taken for confidentiality. They have the right for the freedom of discontinuation of research and cancellation of consent. The research data is not used for any other purposes.

3.4 Plan

We have confirmed the growth of the Japanese rice imported by Quang Nam province government in middle Vietnam in fiscal year 2016. We have worked with skilled Japanese farmers and collected the materials explaining the rice cultivation.

We also developed IoT equipment explained above to recognize agricultural work and farm condition. In the coming time, we will conduct contextual inquiry on Vietnamese farmers and facilitate these IoT devices.

As more examples of the NMF are used, the estimation accuracy improves. In order to repeat the rice cultivation which takes 4 to 5 months in one cycle, this case will take some years to achieve motivation factors to improve the manual.

4 Conclusions

The paper proposes a model to impart Japanese farming technique to Vietnamese famers. It focuses on improvement of a manual which includes Vietnamese farmers' motivation factors. The motivation factors are figured out by MNF to transform behaviors of farmers taken with IoT. It utilizes Vietnamese evangelist to explain the manual to the farmers to make them motivated to the farm work.

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