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The Usefulness of the Artificial Intelligence Data in Analyzing the Skin in the Era of the Fourth Industrial Revolution

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Abstract

In the World economy forum Global Challenge Insight Report titled "The Future of Jobs-Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution (FIR) in 2016", a new industrial revolution was predicted to occur in the near future. This is followed by the opinion that it would be mandatory to prepare for the FIR because it will definitely change people's way of working, consuming and thinking. There is a controversy as to the potential of AI in health care. To date, however, remarkable achievements have been made in the field of medicine, particularly entailing dermatology. Therefore, this study explored the usefulness of the AI data in analyzing the skin in the era of the FIR. The current study finally included a total of 300 subjects, for whom a self-reporting questionnaire survey was performed between June 09 and July 18, 2020. The current study proposed the following hypothesis: The AI data might be useful in analyzing the skin in the era of the FIR. This hypothesis was accepted. In conclusion, the current study suggests that the AI data might be useful in analyzing the skin in the era of the FIR. But this deserves further study.

Keywords

Beauty, Skin, Artificial Intelligence, Fourth Industrial Revolution, Cosmetics

1. Introduction

To date, progress in information and communication technology (ICT) has led to the advancement of informationalization [1] [2] [3]. Information and communication have accounted for a great part of industries and daily lives. They have therefore been considered a high priority [4] [5].

In the World economy forum Global Challenge Insight Report titled "The

Future of Jobs-Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution (FIR) in 2016", a new industrial revolution was predicted to occur in the near future. This is followed by the opinion that it would be mandatory to prepare for the FIR because it will definitely change people's way of working, consuming and thinking [6].

The industrial revolutions have caused changes in the labor market; they are characterized by replacement of human labor with machines replacing human labor. In other words, the first, second and third industrial revolutions can be briefly described as the replacement of manual work with the invention of a steam engine, the emergence of electric energy enabling mass production and the initiation of an automation era based on the internet and computer [7] [8]. This will be followed by the emergence of the FIR, whose characteristics include cyber-physical system and artificial intelligence (AI) [6].

Diverse factors are involved in the emergence of the FIR. The AI based on high-speed networks and interfaces would raise the speed of production and it would promote the big data-based business models [6]. Thus, the world has minimized differences in time and space between the countries with the development of ICT, thus contributing to creating a single economic system. This can be well verified by the social network services. It is also expected that operational technology or cyber-physical system devices will monitor, coordinate and integrate information on a real-time basis [6].

The FIR is defined as a combination of technologies that are available on the market from various fields [9]. Such technologies are accompanied by concurrent growth in the collection and availability of data on the shop-floor [10]. Therefore, their use in an enterprise is often associated with the intensive implementation of the ICT in the context of digitization of industrial processes, cyber-physical systems, Internet of Things (IoT), human-robot collaboration and real-time big-data processing capabilities [11].

There is a controversy as to the potential of AI in health care [12] [13] [14] [15] [16]. To date, however, remarkable achievements have been made in the field of medicine, particularly entailing dermatology [17] [18] [19].

Given the above background, this study explored the usefulness of the AI data in analyzing the skin in the era of the FIR.

2. Materials and Methods

2.1. Data Collection

The current study included a total of 321 subjects (n = 321) who were located in Seoul, Korea, for whom a self-reporting questionnaire survey was performed between June 09 and July 18, 2020. They were given questionnaire sheets using a convenience sampling method. Eligibility criterion for the current study is the experience of observing other customers' complaint behavior. The subjects were informed of purposes and implications of the current study. Before study participation, they provided a verbal consent.

The self-reporting questionnaire survey was performed with the help of a re-

search company, whose results were assessed based on a 5-point Likert scale (0 = "Never" and 4 = "Always"). Thus, a total of 12 questions, including five about demographic characteristics of the subjects, were prepared.

After the exclusion of 21 incomplete responses, a total of 300 valid responses (n = 300) were finally analyzed.

2.2. Hypothesis Testing

The current study proposed the following hypothesis:

H: The AI data might be useful in analyzing the skin in the era of the FIR.

2.3. Statistical analysis of the Data

Data was presented as mean ± standard deviation or number with percentage, where appropriate. The SPSS for windows Ver. 18.0 (SPSS Inc., Chicago, IL) and AMOS Ver. 18.0 (IBM Co., Armonk, NY) were used to analyze the data. A P-value of <0.05 was considered statistically significant.

Standardized factor loading was calculated, and the data-model fit was evaluated based on the χ^2-goodness-of-fit indices (GFI) and adjusted goodness-of-fit indices (AGFI). Based on a structural equation model, the degree of freedom (*df*), the number of variables that will be estimated (Q), root mean square residual (RMR), root-mean-square error approximation (RMSEA), normed fit index (NFI) and comparative fit index (CFI) were calculated. Moreover, unstandardized coefficient, factor loading, statistical significance, squared multiple correlations (SMCs), average variance extracted (AVE) and confidence were calculated.

3. Results

3.1. Baseline Characteristics of the Subjects

The subjects are composed of 133 men (44.3%) and 167 women (55.7%) (**Figure 1**). By the age, the subjects aged between 30 and 39 years old were the most prevalent (148/300, 49.3%) (**Figure 2**). By the type of employment, self-employed subjects or employees of a corporation were also the most prevalent (123/300, 41.0%) (**Figure 3**). By the monthly income, the subjects with a monthly income of USD 1848.89 - 2773.34 were also the most prevalent (95/300, 31.7%) (**Figure 4**). Baseline characteristics of the subjects are presented in **Table 1**.

3.2. Confirmatory Factor Analysis

The goodness-of-fit was satisfactory (χ^2 = 102.407, *df* = 48, P = 0.000, RMR = 0.035, GFI = 0.944, AGFI = 0.909, CFI = 0.970, NFI = 0.946, RFI = 0.926, IFI = 0.971 and RMSEA = 0.062). Moreover, the standardized factor loading exceeded the critical level of 0.5 and the concept reliability did that of 0.7, both of which were found to be statistically significant.

3.3. Hypothesis Testing

Results of hypothesis testing are presented in **Table 2**; the current study accepted

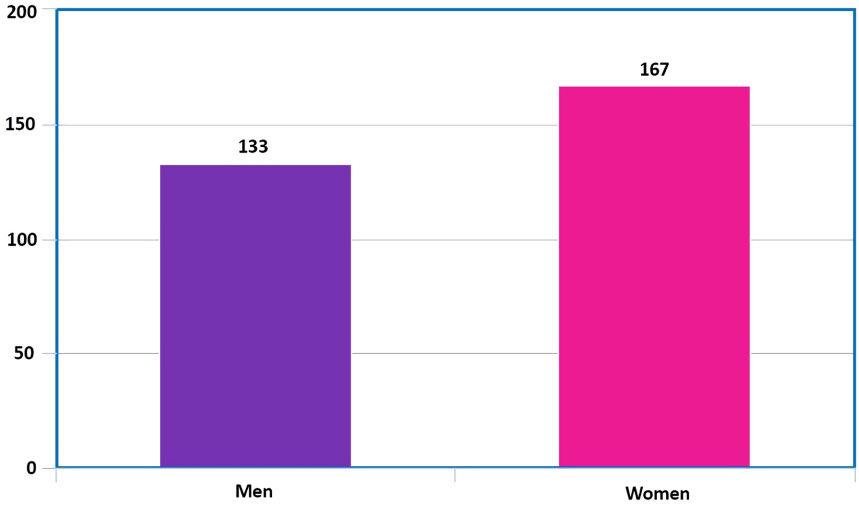

Figure 1. Sex distribution of the subjects (n = 300). The subjects are composed of 133 men (44.3%) and 167 women (55.7%).

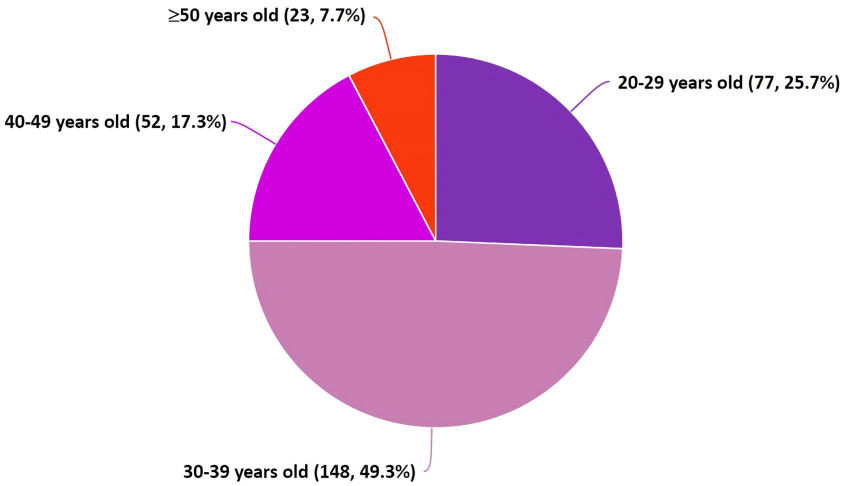

Figure 2. Age distribution of the subjects (n = 300). The subjects aged between 30 and 39 years old were the most prevalent (148/300, 49.3%).

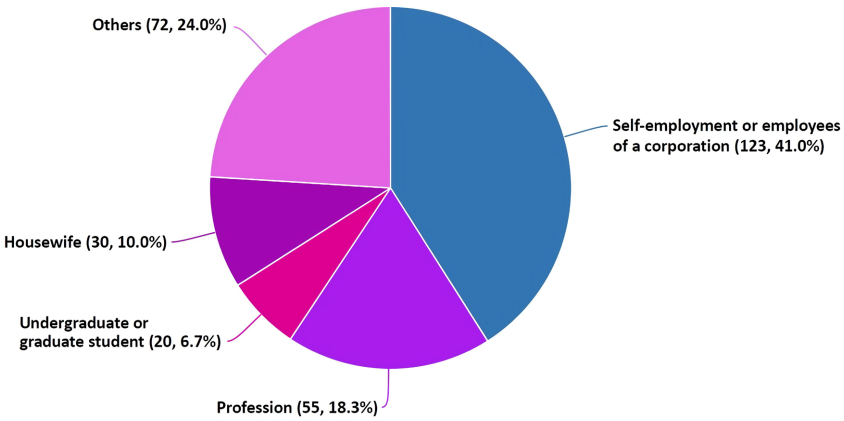

Figure 3. The distribution of the type of employment (n = 300). By the type of employment, self-employed subjects or employees of a corporation were also the most prevalent (123/300, 41.0%).

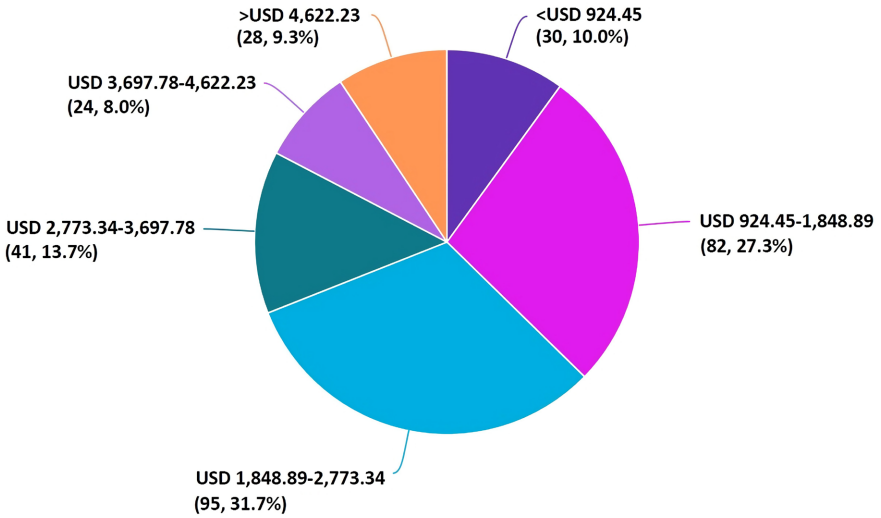

Figure 4. The distribution of the monthly income (n = 300). By the monthly income, the subjects with a monthly income of USD 1848.89 - 2773.34 were also the most prevalent (95/300, 31.7%).

Table 1. Baseline characteristics of the subjects (n = 300).

Variables	Values
Age	
20 - 29 years old	77 (25.7%)
30 - 39 years old	148 (49.3%)
40 - 49 years old	52 (17.3%)
≥50 years old	23 (7.7%)
Sex	
Men	133 (44.3%)
Women	167 (55.7%)
Occupation	
Self-employment or employees of a corporation	123 (41.0%)
Profession	55 (18.3%)
Undergraduate or graduate student	20 (6.7%)
Housewife	30 (10.0%)
Others	72 (24.0%)
Monthly income	
<USD 924.45	30 (10.0%)
USD 924.45 - 1848.89	82 (27.3%)
USD 1848.89 - 2773.34	95 (31.7%)
USD 2773.34 - 3697.78	41 (13.7%)
USD 3697.78 - 4622.23	24 (8.0%)
>USD 4622.23	28 (9.3%)

Table 2. Hypothesis testing.

Hypothesis	β	T	P	Results
The AI data might be useful in analyzing the skin in the era of the FIR.	0.382	5.760***	0.000	Accept

Abbreviations: AI, artificial intelligence; FIR, fourth industrial revolution. **Model's goodness-of-fit:** χ^2 = 102.407, df = 48, P = 0.000, RMR = 0.035, GFI = 0.944, AGFI = 0.909, CFI = 0.970, NFI = 0.946, RFI = 0.926, IFI = 0.971, RMSEA = 0.062.

the hypothesis "The AI data might be useful in analyzing the skin in the era of the FIR".

4. Discussion

Dermatology is a specialty area that undergoes involvement of digitalization, telehealth and informatics [20]. This is accompanied by the increased use of the AI, which has led to its application to the dermatological practice [21].

Dermatological practice undergoes rapid evolution; there have been considerable changes in the diagnosis and treatment of dermatological conditions thanks to the emergence of new technology. Computer algorithms and the AI are helpful tools for dermatologists. Moreover, machine learning is also a useful tool in that it induces computer programs to learn automatically based on experience without explicit programming instructions [22] [23]. A complete understanding of the AI would therefore be mandatory.

The current study showed that the AI data might be useful in analyzing the skin in the era of the FIR. This is in agreement with a previous published study; according to a recent study, 85.1% of 1271 dermatologists were aware that the AI would play a pivotal role in making an accurate diagnosis of skin conditions [24].

Still, however, there are limitations of the applicability of the AI to dermatological practice, as follows: First, there is an insufficient amount of high-quality image data about diverse skin diseases. Second, the AI can be applied to dermatological practice only in a limited scope, although there is a great variability in the type of skin condition. Third, the AI-based diagnosis of dermatological diseases may cause legal and ethical issues in association with the data privacy [25].

5. Conclusions

Skin diagnosis is currently performed for diagnostic, therapeutic and cosmetic purposes. With evolutionary changes in online market and personalized beauty services, there has been a continuous increase in demand for an easy, accurate method of skin diagnosis. In particular, an image analysis technology has been applied to skin diagnosis; its advantages include cost-effectiveness and high accessibility. Therefore, it is efficiently combined with the AI to provide customers with more personalized services. Recently, the AI has been of increasing interest; it is actively used to develop cosmetics and to recommend personalized cosmet-

ics to customers. It is also expected that a deep learning-based automatic skin diagnosis technology will also be available for stakeholders in the cosmetic industry. Thus, it has greatly contributed to opening the era of beauty technology as a new paradigm in response to the demand of the FIR.

In conclusion, the current study suggests that the AI data might be useful in analyzing the skin in the era of the FIR. But this deserves further study.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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