Constructing an application for the data collection on landscape design planning to physical and mental health

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ABSTRACT

Background: For most people, the natural environment is recommended as an affordable health promotion method.

Goal: Develop an app to collect people's health information and return people's environmental health prediction scores. The data can also be used in landscape planning and design in the future to design healing fields for people to use.

Discussion: Experiment with a preliminary developed application. The research results show that the altitude of Toucheng Farm is slightly higher than that of flat land; when the temperature is low, the heartbeat in the physiological response increases, and the weather and relative humidity of the day will affect the preferences of tourists.

Conclusion: Climate and environmental factors affect personal physical and mental health and social distancing strategies caused by the global epidemic this year. The next step of the research is to consider the impact of climate and social distance factors on people's health and incorporate them into the health route system.

Keywords: *Mobile app, Health, Nature contact, Climate change, Landscape design*

INTRODUCTION

The Sustainable Development Goals were adopted by all member states of the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development, which set out a 15-year plan to achieve the goals. The agenda had 17 goals and 169 targets. Goal 3 (Good Health and Well-Being), Goal 11 (Sustainable Cities and Communities), and Goal 15 (Life on Land) are closely related to the issue of green space in the environment as well as to physical and mental health.

According to the World Health Organization, depression is a common mental disorder. Globally, more than 264 million people of all ages suffer from depression. Meanwhile, there is mounting evidence confirming that contact with nature can help reduce negative states, such as stress and depression, restore attention, boost positive emotions, and induce relaxation (Berto, 2005, 2014;

Kaplan & Kaplan, 1989; Kaplan, 1995; Ulrich et al., 1991). Studies have found that watching window scenery and green environments results in the participants experiencing lower blood pressure, electromyographic and electrodermal values, and heart rate (Hartig et al., 2003; Ulrich et al., 1991). There are many theories and hypotheses related to this field of research, such as the preference matrix (Kaplan & Kaplan, 1989), the attention recovery theory (Kaplan & Kaplan, 1989), and the stress reduction theory (Ulrich, 1984). The use of a natural environment in commuting to and from work every day is related to better mental health, especially for active commuters (Zijlema et al., 2018). The increase in commuting time to get off work may even lead to an uplift of mood by bicycle or walking (Lancee, Veenhoven, & Burger, 2017). Related research results indicate that exposure to natural environments is recommended as an affordable health promotion method for most people.

The project plans to use wearable devices and apps to collect people's physical and mental health responses during activities in the environment. The purpose of the project is to help improve people's physical and mental health, and to use health information as a reference for landscape design. Therefore, the core question of the project is: How do people connect with nature and benefit from their physical and mental health, and what environmental factors will affect human health?

METHOD

This research hopes to build an application that collects people's physical and psychological responses in the environment to provide users with personal health information. Moreover, the big data of personal health can also provide landscape designer with health information about the interaction between people and the environment. The following is the description of the application system to the design process:

I. HealthCloud app:

We could collect psychological and physical data from individuals with iPhone and Apple Watch, and integrating environmental information to track locations, altitudes, and weather (e.g., temperature, humidity, crowds, etc.) to record environmental features and personal heart rates, and it creates short psychological surveys that could be answered on Apple Watch, such as perceived restorativeness and preferences. HealthCloud is still being developed by Chang (2018–-2020, Council of Agriculture, Executive Yuan).

II. Cloud Computing:

1. Predict Healthy Scores: Computes the Healthy Scores of uploaded scenes through landscape features and an Empirical Health Image Database (collect research journals related to environmental and health benefits, with environmental photos).
2. Environmental and Health Effect Analysis: Analyze the correlation between psychological data and environmental characteristics to explore how the environment affects human health.

III. Health Benefits:

1. Personal Health Benefits: Collect personal heartbeat, feelings about the environment, and environmental information to understand the user's health status and track long-term data changes. Conversely, the application can predict the health benefits that the field can provide through the user's upload of environmental photos of the location.
2. Public Health Benefits: Physiological and psychological big data can be tracked and analyzed for a long time according to landscapes, times, and seasons. Moreover, maps of environmental emotions and preferences can be generated. Furthermore, the analysis also distinguishes the effect of the environment on various age groups.

IV. Landscape Design Planning:

Health benefits information can be used as a design guide for landscape planning and design, and it can be analyzed with other environmental ecology, weather, and terrain data to create a therapeutic environment that is more in line with people's mental health.

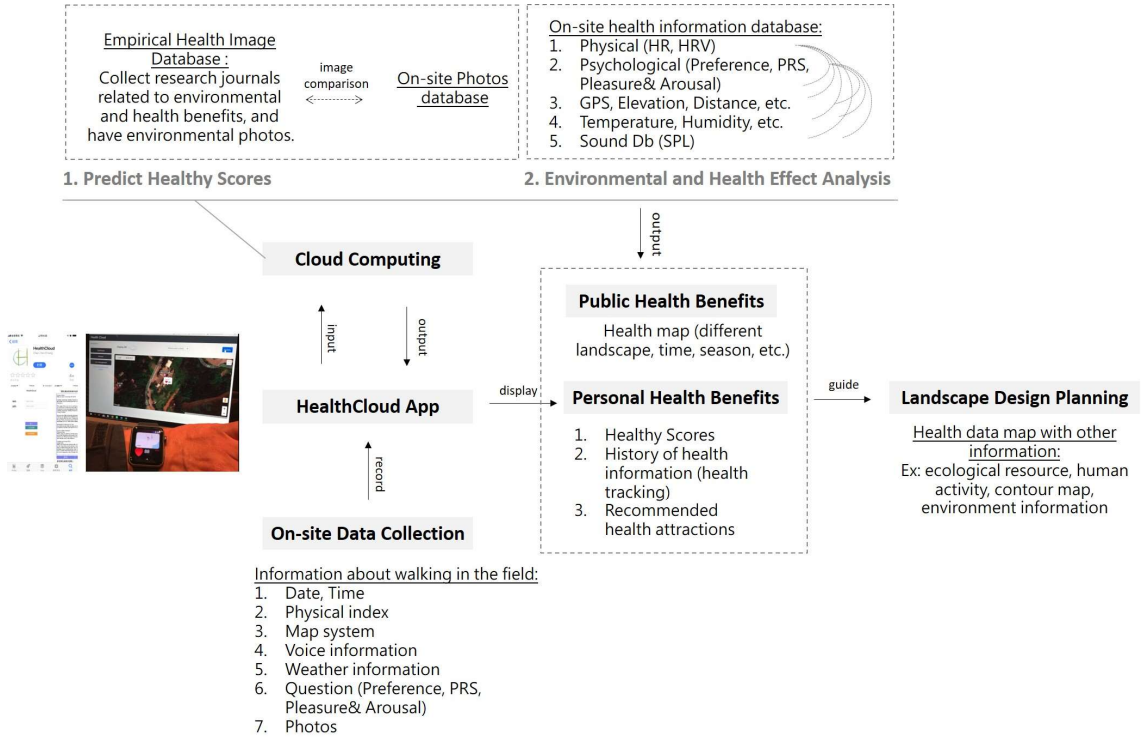

Figure 1: HealthCloud application system

HealthCloud application system Pre-test:

In this study, we first collect physical and psychological field data to build the database. Subsequently, a cloud system will be established to predict healthy scores and environmental and health effect analysis. Finally, the design guidelines will be drawn up with health information.

The pre-test method of data collection employed in this study was the HealthCloud app, which was developed by Dr. Chang's team in 2018. An Apple Watch Series 4 and iPhone 7 were used as experimental tools to collect the physiological and psychological data of the subjects' activities and the environmental information of their locations. The physiological data of Apple Watch currently only cover heart rate data collection in Taiwan. In our experiment, we collected average heart rate per minute as a measurement. The psychological questionnaire items were composed of three categories and measured on a five-point Likert scale, with 1 meaning strongly disagree and 5 meaning strongly agree. The content included Perceived Restorative Scale (Berto, 2005), Preference (Herzog, 2004), and Satisfaction. Background information included personal information, such as gender, age, and daily exercise frequency. The analysis method compared the physiological and psychological differences between different locations with data such as heart rate, GPS location, latitude, and longitude altitude, date and time recorded by Apple Watch. The complete procedure for the on-site experiment included the following: (1) explaining the research content and process to the subjects and obtaining their

consent; (2) asking the subjects to participate in the experiment according to the instructions and simultaneously collecting response data; and (3) filling out the questionnaire.

RESULTS AND DISCUSSION

The pre-test experiment was conducted at Toucheng Farm in Yilan County, Taiwan. A preliminary analysis was performed on the collected data to understand the interaction between the environment and human health. Overall 40 people participated in the experiment, which took place from August to November 2018. The analysis results are as follows.

Toucheng Farm has the characteristics of an attention restoration environment, which is positively correlated with satisfaction (r=0.554). The correlation between heart rate and altitude (r=0.03) shows that altitude affects the speed of the heart rate. In Toucheng Farm, there is a stream landscape, which can enhance tourists' preference for it. Based on the physiological indicators, this study found that heart rate and preference are highly positively correlated (r=0.879), which means that tourists like the natural stream landscape, which may increase their heart rates. As for microclimate data, it was found that when temperature and heart rate are highly negatively correlated (r=-0.763), temperature and preference are highly negatively correlated (r=-0.950). The relative humidity is highly negatively correlated with preference (r=-0.980). In addition, the research results found that Toucheng Farm has a slightly higher altitude than flat land. When the temperature is low, the heartbeat in the physiological reaction increases. Simultaneously, the temperature and relative humidity of the day will affect the preference of tourists.

CONCLUSION

Nature (waterscape) is Beneficial to Health

We found that tourists have a higher preference for stream landscapes and a higher degree of satisfaction with the environment with attention restoration characteristics. A number of studies have proven that there is a close relationship between the measure of preference or the beauty of the scenery and the perceived quality of restoration (Purcell, Peron, & Berto, 2001). In various comparisons of natural and urban environments, studies have found that people perceive natural environments as more restorative than urban environments. Moreover, individuals in need of restoration demonstrate more nature-oriented preferences (Van Den Berg, Hartig, & Staats, 2007). The HealthCloud application system will be able to recommend users based on personal preference for the environment and route selection of the closest distance.

Weather and Health

Extreme weather events can drastically affect not only physical health but also mental health. In recent years, some studies have focused on the impact of climate change on mental health. Heat stress that is directly caused by heat waves has been associated with mood disorders, anxiety, and physical and psychological fatigue (Padhy et al., 2015), and influence mental health in several ways (Cianconi & Janiri, 2020). From the analysis results of the pre-test data, we know that the environmental climate will affect our physical and psychological conditions. Although there is a dearth of research evaluating the impact of climate on mental health, some studies have shown that rising temperatures may have a negative impact on mental health (Majeed & Lee, 2017). Humidity exacerbates the negative link between hot weather and mental health (Ding, Berry, & Bennett, 2016). A study in Québec indicated that emergency

departments have seen an increase in psychological and psychosocial problems with higher average temperature and humidity (Vida, Durocher, Ouarda, and Gosselin, 2012). Thus, this may be a good time to understand the healing effects of nature. However, as reiterated in previous studies, worries about climate change are increasing. Ironically, one of the best health benefits is being in contact with green spaces. The HealthCloud application will be able to add climate factors to predict comfortable routes so that people can get better health benefits.

Establishing a Healthy Environment Computing Model for Better Scenes and Routes Selection

We used the HealthCloud application to collect large data about the participants' physical and psychological conditions to build a model that can provide feedback regarding each user's current state with a healthy scenes or route selection and possible activities. It is hoped that based on this cloud system, research can be extended to more fields, which will help in collecting and establish databases about various environments. The model will be capable of more accurately predicting the state of the subject in various environments and give suggestions in terms of routes and activities. How does the route suggestion feature affect health? As humans move about in the environment, such as while walking, passing through a natural environment may provide a respite. Although short, it will still interrupt the resource consumption process. In the long run, brief restorative experiences may bring cumulative benefits. A study showed that the participants' moods did not improve when walking in an urban environment, but they exhibited positive moods when walking in a green environment (Stigsdotter, Corazon, Sidenius, Kristiansen, & Grahn, 2017). On a related note, how has the COVID-19 pandemic affected daily life? COVID-19 has rapidly affected our day-to-day life, including our health, social practices, and the economy. In addition, social distancing measures have important effects on activity participation. Many people have to work from home, and most leisure activities are cancelled. As a result, the demand for travel has decreased, with the largest decline in the use of public transport. Meanwhile, walking and cycling are important ways to maintain satisfactory health benefits. Therefore, policymakers and planners can try to encourage active travel while public transportation operators should focus on creating safe ways to use public transportation (De Vos, 2020). Connecting this thinking to our HealthCloud application, we can map popular time information from Google to plan routes with locations that are not crowded.

ACKNOWLEDGEMENTS

We would like to thank the Council of Agriculture (Executive Yuan 109 農科-7.5.4-輔-#1(1)) for their scientific support.

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