SUSI GENE: a portable robot as venting, recording and sharing tool for improving mental health condition

Mental health condition is a major challenge throughout the world, yet mental health services in many countries are struggling to meet such needs. Studies have shown innovative intervention can have positive impacts on patients' mental health conditions. This paper presents SUSI GENE, an egg-shaped portable robot, designed for people with mood disorders, including major depressive disorder, bipolar disorder, etc. Through interactions, SUSI GENE attempts to help patients increase their self-awarenesses, vent their emotions, face their inner conflicts, and reappraise their problems in a less negative approach.

CCS Concepts: • **Human-centered computing** → **User interface design**; *Sound-based input / output*; • **Social and professional topics** → **People with disabilities**; • **Hardware** → *PCB design and layout*; • **Applied computing** → **Consumer health**.

Additional Key Words and Phrases: datasets, neural networks, gaze detection, text tagging

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1 INTRODUCTION

-what is susi gene

SUSI GENE is an interactive emotion assistant. It consists of a tangible egg-shaped robot along with an interface. The robot receives vocal inputs from a user; the mobile phone converts that radio to text for natural language processing; while the interface accordingly generates a virtual creature for the user as well as documents these data.

Past research indicated that people with mood disorders demonstrate overall satisfaction with the usage of mobile technology to increase their mental well-being.[1]

A large variety of products and research prototypes have made it possible for people to self-monitor their mental conditions, but most of these systems are designed as apps on mobile devices, and thus do not involves tangible interactions.

SUSI GENE also incorporates recording capabilities and requires some operations on mobile devices. However, it has several significant differences. We designed SUSI GENE as an egg-shaped portable robot aims to provide the user a more intuitive experience while sharing his or her stories and feelings. For our current prototype, the user is expected to talk directly to the egg and hold the button that corresponding to his or her current emotion. There are eight emotions, each of them is corresponding to a button with a unique shape. After that, the user needs to place the egg on the back of a mobile device and, through the usage of Near-Field-Communication(NFC) technology, wait for the device pairs with the robot to receive and interpret the piece of audio and vibrates as a feedback signal. During that time, the radio is converted to text for natural language processing(NLP), the text would be split into several keywords. The selected

Author's address:

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keywords would be analyzed in reference to the HowNet and NTUSD sentiment lexicon, and the “emotion gene” is therefore finalized. After a brief vibration, a creature would hatch out and shown on the screen. The picture of the generated creature and the radio of his or her words will be saved for later usage. The user can not only review those past experiences but also share them to his or her friends, family members, or professional counsellors.

The interactive process imitates the natural hatching of the oviparity animals. Our design assumption is that the process of the young break through its shell is especially inspiring and may bring positive impact on the level of enjoyment.

2 BACKGROUND

Mental health conditon, which causes the most Years lost of Desiabilities(YLD) in the whole world (ref), is influenced by many factors. According to Monroe and Simons’ model, these factors can be concluded as diathesis (predisposition/vulnerability) and stress (triggers). The model assumes every individual, no matter of what innate diathesis, has possibilities to develop mental health conditon under certain amount of stress. Thus, the proper react mechanism to the event of stress is the main method to reduce individual’s possibility of mental health conditon. Based on the interview of 11 subjects who suffer from mental disorder, we locate two mechanisms: low-recognition of stress-caused emotion changes, and emotion-driven social isolating as the most notable improper ones that may raise the possibilities of mental health conditon and continuely worsen when the mental health condition becomes severe. Recent research and products provide solution by replacing the communicate subject from human to artificial inteligence. However, there is little interactive solution focusing on changing these two mechanisms by guiding the individual to apply new actions to increase diathesis. Therefore, we designed SUSI: an robot with tangible interface to help users shadowing their stress event and related emotion changes through oral expression and generate gamificated communication material to share in real-life relationships.

Today, mood disorder, including depression, has became the worldwide leading cause of the Years Lived with Disability (YLDs). Many countries have started to pay increased attentions to people’s mental health conditions, and a number of plans aimed to make mental health services more accessible have emerged. However, these approaches, including one-to-one counseling, are mostly resource-intensive since each patient should be addressed individually.

3 HARDWARE DESIGN

SUSI Gene is an egg-shaped portable robot, its dimensions are 62 mm in diameter and 80 mm in height. Its center of gravity is low, so it can stand on the back of the phone like a tumbler.

The SUSI Gene prototype is comprised of three main hardware components: the main PCB with an Arduino NANO BLE Sense and other necessary components on it, a battery, and a 3D printed shell.

3.1 Main PCB design

The main PCB integrates a mount for Arduino Nano 33 BLE Sense (with headers), a battery connector, 6 individually addressable Warm White RGBW version WS2812B with integrated drivers, connector for vibration motor and NFC coil, and an I2C port for NFC chip communication.

Also Arduino Nano 33 BLE Sense supports NFC, we cannot drain power from the NFC coil using Arduino itself. It’s necessary to add an additional chip to support wireless charging. We decide to use NXP and embedded it on the coil PCB. The communication protocol between NXP and Arduino is I2C.

SUSI Gene is illuminated in RGBW using WS2812B on main PCB which are wrapped inside the 3D printed enclosure to provide the robot's state display as well as full color indicating.

The communications chipset on the Nano 33 BLE Sense can be both a BLE and Bluetooth client and host device. The main communication method between SUSI GENE and your phone is BLE.

The IMU(LSM9DS1) can detect the movement of SUSI GENE. When the user move or touch the egg, it will vibrate or glomming depending on current feelings.

3.2 Power consumption analysis

SUSI Gene is powered by a 4000mAh 5V battery(3.7V 1S LiPo with boost PCM). Most of the power in the robots are consumed by the LEDs and Arduino. The current draw is approximately 200 mA during typical use. Thus, with a 4000 mAh battery, SUSI Gene is capable of working for about 20 hours without NFC wireless charging. Furthermore, with ultra low power consumption modes of Arduino, it can work longer when enabled.

3.3 NLP solution

One of the most important reason of using Arduino Nano 33 BLE Sense is that it has the ability of Embedded Artificial Intelligence. It is possible to run Edge Computing applications (AI) on Nano 33 BLE Sense using TinyML. We can create our machine learning models using TensorFlow Lite and upload them to it using the Arduino IDE. The microphone(MP34DT05) on board can record your voice imformation. With those feature, we can get voice recognition results with NLP model.

However, the calculate ability of Arduino is too low to run complicate algorithms. After lots of efforts, it can only recognize simple phrases. At last, we decide to use smart phone and its microphone instead. But in the near future, we will integrate NLP process in SUSI GENE itself by using more powerful chip supporting tenserflow or other machine learning algorithms.

3.4 NFC PCB

With NFC tag in the bottom of SUSI GENE, smart phone can recognize it using different UID of NFC tag and begin timing.

ISO/IEC 14443A/MIFARE

4 DISCUSSION AND FUTURE WORK

In the future, we wish to integrate NLP process in SUSI GENE itself by using more powerful chip supporting tenserflow or other machine learning algorithms.

If we still want to put NLP on smart phone instead of emmbedded system, we can also use nRF52840 rather than Arduino Nano 33 BLE Sense to make the egg smaller and more efficient.

REFERENCES

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