Stroke Striker

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***Abstract*—Our model is an "active" stroke detector-strike stroke. Stroke is a representative acute severe disease that ranks as the [1] fourth cause of death in Korea and [2]the fifth cause of death in the United States. The sooner the better, but [3] It is most effective to remove blood clots within an hour, and if not, treatment should be done within up to 3 hours to reduce side effects.**

However, since CT, MRI scans, and diagnosis time after arriving at the hospital should be considered, [4] The golden time for stroke should be about an hour before arriving at the hospital.However, the time of stroke after the onset of prognostic symptoms cannot be predicted, so if you see prognostic symptoms, you should go to the hospital right away. Fortunately, [5] stroke has a reliable pre-hospital diagnostic method called BE-FAST (Balance, Eyes, Face, Arm, Speech, Terrible headache). Among them, Face-facial expression changes caused by paralysis of facial muscles are very obvious, so you can make a relatively accurate diagnosis.

We focus on that.
Of course, there are currently many applications that can be used to diagnose themselves using this method. But they're all "passive" applications which you have to turn on the app and take pictures.

The Point of this project lies in "active". Home appliances, typically refrigerators and TVs, are used by facing with users. Especially in the case of refrigerators, we know empirically that everyone opens it once a day, even if there's no specific reason. According to a 2012 Consumer Electronics Industry Survey, a family of four opens the refrigerator on average 40 times a day and it means 10 times a day per person. Paying attention to this, [6] LG Electronics not only achieved great results with the design of "Magic Space" but also significantly reduced electricity use at home. [7]In addition, Americans open refrigerators an average of 33 times a day, according to ENERGY STAR, a U.S. environmental protection agency.

We pay attention to these behaviors. The refrigerator is equipped with a camera module to recognize the facial expressions of the user when standing in front of the refrigerator. If stroke was detected, it informs the user right away. Unbeknownst to us, the disease is diagnosed and even follows up. Active appliances protect our healthy lives in real-time. If this technology is applied to all home appliances, The house can no longer be a space for living, but a diagnostic center for each individual. You're worried about privacy? We've already prepared a countermeasure for this-.

Our project is UP version of refrigerator.
This is Innovation for a better life. It makes Life to be Good.

TABLE I
A LIST OF ROLE ASSIGNMENT

Roles	Name	Task Description
Development Manager	Lee Seungsu	Lee Seungsu was responsible for designing the overall concept of the software and finding the basis for various claims.
Software Development	Park Geonryul	Park Geonryul was in charge of the actual implementation of systems and machine learning. In addition, a basic framework for document creation was created.
Customer	Elia Ayoub	As a customer, Elia uses the designed products and services produced by the team and delivers an objective feedback accordingly.
Document Analysis	Ryan Jabbour	Ryan was given the task of checking all the documentation to present and the logical development of the project.

I. Introduction

A. Motivation

- Problem: Unannounced emergencies, poor initial response
  [8]According to the National Statistical Office of the Republic of Korea, nearly 60,000 of the total 120,000 stroke patients in 2021 were not transferred to the emergency room until more than six hours after the outbreak. Fewer than 15% of the people arrived at the emergency room in less than an hour, and half of them were patients living in the Seoul-Gyeonggi area. [9] The number of patients at risk increases in the provinces, but the medical infrastructure is insufficient, so initial diagnosis or prevention is not possible, and even if it could be, follow-up will inevitably be delayed. After all, time is the lifeblood of a stroke. In order to do that, you need to quickly notice the signs. But it's rare to check for signs of stroke "every day". We think the capture in everyday life is key. To do this, we'll have to mount active detectors on the ones we face most frequently. Additionally, it is not just a project for the elderly. [8] According to the National Medical

Center, the incidence of stroke among people in their 20s and 30s is rising every year. Because of the stereotype that stroke is the disease of the elderly, even if you have premonitory symptoms, you will often pass it on, thinking of it as another reason. [10] As the proportion of single-person households in Korea approaches 34.5%, chances for them to recognize acute diseases in the early stages are also decreasing. In order to become a better society, we must overcome this.

The reality is that people's recognition rate of early stroke symptoms is also very low. [11] According to the Korea Centers for Disease Control and Prevention, only 54% of all respondents were correct for early stroke symptoms. Although awareness reached a high of 61% during the pandemic in 2019 - presumably because people cared a lot about health issues due to pandemic. It has been low since 2019. Even though we are living in an information society, this figure is that we don't usually think about stroke, and now you can see that why the effectiveness of passive stroke detection is very low.

The problems we thought of are summarized as follows. First, people aren't as wary or concerned about strokes as we might think. Second, when a stroke occurs, it is quite rare to arrive at a hospital within an hour, the golden time, and if it can, most of them live in the metropolitan area with medical infrastructure that allows immediate emergency action. Third, the elderly, who are at high risk of getting the disease, are concentrated in the provinces where have no infrastructure, and have low awareness, so it is unlikely to respond to premonitory symptoms. Fourth, although a situation where the incidence rate in their 20s and 30s is rising, their vigilance is very low. Fifth, as the number of single-person households increases, there are fewer opportunities for them to recognize and initial responses are becoming insufficient.

In order for the passive detector to be effective, people of all ages must be aware of stroke on their own and check it periodically. So the effect of it does not seem to be able to be enhanced by any method-promotion, campaign, etc. -If this could be elevated, We think [12]the prognostic indicator for stroke should have been more positive.

Therefore, what we need is an "active daily checker", which we think can be made through home appliances, typically refrigerators or TVs.

- Solve

  As I said at the beginning, [7] We open the refrigerator once a day for a reason or not. Our concept uses this habit. There are already many refrigerators equipped with IoT technology. We're going to turn up our home appliances by locating a camera module here. The refrigerator detects the person's face and its landmark through computer vision when a person stands in front. Among BE-FAST diagnostic methods, if facial expressions such as paralysis of one facial muscle, are detected, stroke-striker notify it right away. The notification method is that if you have a refrigerator with a display, it can tell you through the display, and if you have not, it can tell you through a push-message on your phone application (ThinQ) or use AI speaker (NUGU). At a later stage, it will guide you to the nearest hospital where first aid for stroke is available, and automatically connect to 119 if the user wants. Since fixed cameras may not respond appropriately depending on the user's physical characteristics, [13] multi-angle vision technology is applied to detect users from various angles. This creates a true daily active detector beyond the limits of different physical and home structural characteristics for each user.

- Expectation

  As the artificial intelligence field is rapidly developing and computer vision is a technology that occupies a large proportion of it, it is highly likely to detect user behavior or face and develop it into various medical diagnosis. If these technologies are included in each of LG Electronics' home appliances, which currently have a huge share of home appliances compared to competitors, users will be able to continue to actively observe them in their homes, whether in living rooms, kitchens or bedrooms. This will allow the home to become a diagnostic center for individuals that move actively beyond just living spaces, and if this becomes a reality, we expect a very big paradigm shift. [14]We think home diagnostics self care, which is developing recently, is a very important technology field, and the synergy will be great if it is combined with home appliances.

B. Research on Related Materials

- Project MONAI

Fig. 1. MONAI project

MONAI is an initiative started by NVIDIA and King's College London to establish an inclusive community of AI researchers to develop and exchange best practices for AI in healthcare. This collaboration has expanded to include academic and industry leaders throughout the medical field.

This project is similar to our project because it is simply analyzing MRI or CT photographs with AI, but the methods used are different.

- BASLER

  This project provides an overall solution for the vision system. It supports hardware and software at the same time and can analyse images based on machine learning. It is specialized in medical care particularly. However, sensors and cameras are very expensive, so it would be

difficult to apply them to home appliances as they are presented in this project.

- Kaggle Project

Fig. 2. Kaggle

It is a stroke detection project undertaken by Kaggle. It can be used as an AI model for our project but since the algorithm used in this project is based on 2D images, it differs from the 3D recognition we need to use in our project.

- Related Papers
  We researched a number of papers to find the theoretical part for our project.

  1. Multi-Angle detector [15]

  This paper introduce lightweight deep network and combining key point feature positioning for multi-angle face expression recognition. Using robot dog to recognize facial expressions will be affected by distance and angle. To solve this problem, this paper proposes a method for facial expression recognition at different distances and angles,which solved the larger distance and deflection angle of face expression recognition

  2. Raspberry Pi Based Emotion Recognition using OpenCV, TensorFlow, and Keras [16]

  It implement an Emotion Recognition System or a Facial Expression Recognition System on a Raspberry Pi 4. It apply a pre-trained model to recognize the facial expression of a person from a real-time video stream. The “FER2013” dataset is used to train the model with the help of a VGG-like Convolutional Neural Network (CNN).

  3. Connect a Raspberry Pi or other device with AWS [17]

  It tells how to Set up device, install the required tools and libraries for the AWS IoT Device SDK, install AWS IoT Device SDK, install and run the sample appView messages from the sample app in the AWS IoT console.

  4. Realtime Facial Emotion Recognition [18]

  This repository demonstrates an end-to-end pipeline for real-time Facial emotion recognition application through full-stack development. The front-end is developed in react.js and the back-end is developed in FastAPI. The emotion prediction model is built with Tensorflow Keras, and for real-time face detection with animation on the frontend, Tensorflow.js have been used.

  5. Kaggle FER-2013 DataSet [19]

  The data consists of 48x48 pixel grayscale images of faces. The faces have been automatically registered so that the face is more or less centred and occupies about the same amount of space in each image. The task is to categorize each face based on the emotion shown in the facial expression into one of seven categories (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral). The training set consists of 28,709 examples and the public test set consists of 3,589 examples.

  6. Facial landmarks with dlib, OpenCV, and Python [20]

  This document tell What are face landmarks, Understanding dlib’s facial landmark detector, How Detect facial landmarks with dlib, OpenCV, and Python, how visualization facail landmarks with co-lab,Google. Also, it introduce alternative facial landmark detectors, such as MediaPipe library which is capable of computing a 3D face mesh.

II. Requirements

A. AI model

It is an artificial intelligence that determines whether a stroke occurs by receiving a user’s photo. Learn in advance with pictures of people’s faces. Afterwards, you can recognize it by distributing it to a web server and sending a photo through the API. It is an artificial intelligence model that conducts reasoning based on learned data and transmits the result value back to the API to determine whether or not a brain line is drawn to a person’s face based on Face drooping.

B. Web communication

It is an API for web communication. This project supports communication between AWS’ existing artificial intelligence model and Raspberry Pie. Communication is carried out in the json format consisting of key and value, and the prediction is carried out in the POST method.

1) Post: When posting on the web, the user’s image is delivered. The image is delivered by post command and recognizable by the artificial intelligence model. The process of converting images so that artificial intelligence models can recognize them is executed in the handler below to maintain consistency in implementation.

2) Get: The learned artificial intelligence model receives and processes the posted data and delivers the predicted value back to Raspberry Pi. In this case, the value is defined as a probability value indicating a stroke probability. This is because it was judged that there was a high risk to simply distinguish it as 0 or 1.

Fig. 3. Amazon Web Service

C. AWS

It is a server for distribution and learning of artificial intelligence models. It consists of Ubuntu-based x86-64. The virtual instance was created using EC2 and security settings were set to be accessible with Elastic IP.

D. Raspberry Pi

Fig. 4. Raspberry Pi

It controls the camera that takes a user's picture and enables communication with the web server. The artificial intelligence model took on the role of receiving the results of determining whether a stroke occurred based on pictures and notifying users again. This process can be expressed both audibly and visually through the Dashboard with NUGU speakers.

E. Tensorflow Serving

Fig. 5. TensorFlow

When an artificial intelligence model is developed based on Tensorflow, it is necessary to easily proceed with distribution.

F. Handler

It is a collection of the process of transforming and preprocessing the image data transmitted when the learned artificial intelligence model exists on the web server and the process of producing strings to return the predicted result value through API. This function makes it easy to distribute and maintain artificial intelligence models.

G. Disable camera

If it is not used as a camera to take a user's picture, it should be impossible to operate. If the camera is working for privacy protection, it can be displayed like a webcam on a MacBook or cloud the surroundings like a Zoom function.

H. NUGU

Fig. 6. Nugu AI Speaker

In this project with an artificial intelligence speaker, it is possible to aurally transmit the stroke transmitted from the raspberry pie to the user. In addition, the trigger may be recognized so that the user starts photographing when desired.

I. Dashboard

It visually expresses whether you have a stroke. Visually shows the user useful information related to stroke and probability transmitted from raspberry pie, and health written by chatGPT. Examples of useful information are as follows. It includes information on food or lifestyle habits that help with a stroke, and what to do if it develops.

1) Possibility: It expresses the probability value of stroke from the value transmitted through the API. It intuitively transmits probabilities to users by using the speed dashboard of the car as a motif.

2) User's image: Shows a photo of the user. As a result, the user can objectively check his or her state.

3) Cure: This is a space showing the treatment of stroke obtained through chatGPT below. If the user has a high probability of stroke, it can be expressed more prominently.

4) Preventive: It tells users how to prevent stroke obtained through chatGPT below. Even if the probability of stroke is low, it informs the user of prevention and informs the behavioral guidelines on what to do if suspected. This enables active health care.

J. chatGPT

It is a generative AI that generates useful information based on the user's stroke status and probability. It uses API to send questions and receive answers again. The answer is notified to the user through the Dashboard or NUGU.

1) Question: When I ask chatGPT about stroke, we only get information that I have to go to the hospital right away if we do it in a superficial way. It extracts probabilities from the results returned by the artificial intelligence model and directly asks how to choose treatments, prevention, and hospitals.

Fig. 7. ChatGPT

2) Answer: This is the answer I received after I asked the chatGPT in the above question format. This answer is passed to the Dashboard or NUGU and is passed to the user in visual and auditory expressions, respectively.

K. Database

In order to improve the accuracy of the artificial intelligence model, a database for storing images may be required. However, since this can be sensitive to personal information, the project can be implemented without a database.

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