Innovative Solutions Using AI and Cloud Technology

Topics – The “What”:

What the project is about：

In this project, we designed a healthy and safe alarm system through the use of cloud, IoT, RabbitMQ , deep learning and machine learning. This alert system covers most of the scenarios and situations where dangers may occur.

The first is the danger caused by abnormal body indicators. Here, the server will use the data obtained by the wearable device to detect the person’s physical indicators,such as body temperature, heart rate and blood oxygen concentration. If the data is abnormal and outside the standard range, the device will push an alert. In this part, we will use **IoT** and **RabbitMQ** to implement.

The second part is the danger caused by physical injury, such as falls or accidents. At this time, The device will recognize abnormal sounds or you can speak a keyword to wake up the alarm system and connect the police or emergency contacts. In this part, we will use **deep learning** to train the speech recognition model.

The third function is optional, it depends on the time.
The device will also push messages before passing areas where accidents frequently occur to remind users to pay attention. We can't predict when the accident will come, but at least we should be vigilant. In this part, we will use **machine learning** and Google Maps to predict the risk of traffic accidents in real time and inform users of the results.

Overall Solution:

We divide the project into two technical parts – sensor data analysis and abnormal sound recognition.

The first technical part of our project – sensor data analysis.

Due to the limited devices, we decided to use some virtual machines as an alternative to the real wearable device. The virtual machines generate some preset random data to simulate some accidents, such as heart disease and drowning. All the generated data will be sent to the remote RabbitMQ Server, and finally be stored to the relational database like PostgreSQL. Our group also thought about using Data Encryption Technology to ensure the safety of user data. Under normal circumstances, the device will send body indicators every 3 minutes for recording your health trend, but if an emergency occurs, the device will send

related data immediately, then our service will make an emergency call and send an SMS alert to you and your preset emergency contacts.

The second technical part of our project – abnormal sound recognition.

With the help of the microphone built into the wearable device, we can acquire the environmental sounds actively. In our project, we don't need to identify actual semantics, all you have to do is identify the specified sound. Limited by current mobile network charges, our group decided to build a machine learning model in wearable devices to check the current situation in real time. If they call for help or hit the ground, the device will be on-line immediately and establish real-time transmission of current live sound via 5G to our back end. As soon as our server receives the signal, it will also make an emergency call and send an SMS alert to you and your preset emergency contacts.

If possible, our group will build a web frontend site to help users to fetch their previous body indicators and give them related suggestions.

Technical Implementation:

Resources:
Part 1: Abnormal body indicators
For specific indicator values, I think we can use models to predict, input age, height, weight and other information, and use machine learning to get the range of normal heart rate, body temperature and blood oxygen for this person. I didn't choose to do this part because in the last lecture, I remember there was a group that wanted to do something similar, so in our demo, we're going to use a specific person's data.
For IoT+MQTT, we will use what we learn from homework 2.
https://github.com/singgel/mqtt_iot_push

Part 2: Speech Recognition Model
We have not yet decided which language to use for this part. I have just collected models that can be used, but have not yet tried to run them on my own computer.
English:
https://github.com/zvadaadam/speech-recognition
https://github.com/Uberi/speech_recognition
Chinese:
https://github.com/nl8590687/ASRT_SpeechRecognition
https://github.com/xxbb1234021/speech_recognition

Part 3:
Through this part, I have two ideas. The first is to train the model by myself, and the second is to directly use the results given by the model. Could you please give me some suggestions?
HereRoad Traffic Accident Prediction Web Application
https://github.com/meraldoantonio/AccidentPredictor
https://towardsdatascience.com/live-prediction-of-traffic-accident-risks-using-machine-learning-and-google-maps-d2eeffb9389e

related tutorials:
https://towardsdatascience.com/predicting-vehicle-accidents-with-machine-learning-ce956467fa74

Design Considerations:

Step1:
Create a VM as a wearable device(IoT).
To simulate the datas collected by the sensor, we will use a Python program to randomly generate some datas of body indicators.
To simulate an emergency or abnormal situation, we will use the command line, which is equivalent to the occurrence of a sudden situation.

Step2: Send the generated datas or emergency cases to the RabbitMQ Server and save them on the database, generate relative reports and push them to devices.

Step3: Use deep learning to train the speech recognition model on a local computer and use SSH to upload to the Cloud. Use this model on the vm to identify the key words that awaken the alert system.(Backup Plan: Azure API- Microsoft Azure Speech)

Step4：Since we are using the vm, there is no microphone that can be used. To simulate this, we will pre-record the voice as the test case.

step5(optional): We will use machine learning and data from Google Maps to train the Traffic Accident Prediction model, or use the relevant API directly.

step6(optional): If we have time, we will use veu.js to write a simple web front end.
step7(optional): If all the previous steps are successful, we can deploy the project to the server with Docker.

Topics – The “Why”:

The three course keywords of intelligence, innovation and real life have significantly inspired our design process.
Thinking of the part of intelligence, we retain deep learning and machine learning, take the normalized health information as the standard, and obtain real-time health data for comparative analysis. Besides, with the gradual popularization of vehicles, traffic accidents have gradually become a potential safety hazard for all groups of people. Machine learning is utilized to collect accident data and make safe detour suggestions.

In addition, for any population, the untimely handling of emergencies will lead to potential dangers and even threaten life safety. Therefore, in terms of innovation, we bind the special sound recognition and alert system. In the face of sudden disease and hijacking, the device can integrate the collected sound information, such as calling for help, moaning or

screaming, with blood pressure, heart rate and other physical parameters to urgently contact the preset relevant personnel.

As for the real life part, in addition to the personalized application mentioned earlier, we also consider using it in public places. Under the influence of pandemic, the population of patients and medical pressure in hospitals are obvious to people. Our solution can reduce the care burden of medical staff, reduce personnel costs and improve the overall efficiency of hospitals and other medical institutions to a certain extent. At the same time, timely feedback and responses to the needs of patients have greatly reduced the potential risk.

A series of ideas derived from these three keywords confirm the feasibility and practicability of our solution

Implementation Considerations:

Who is the solution intended for
When should the solution be used
Where should the solution be used

First, this project is mainly aimed at people with clear safety needs, such as the elderly and children. When the risk factor is present, it will work.

1. For the existing wearable devices, there are too many functions, the operation is too complex, some old people may not understand and it is hard to remember the operation. A simpler design helps users become more familiar with each feature.

2. Many of the features of the current popular wearable devices are unusable and wasteful. If we cut out the money which is spent on other features, make the cost down so that more people can afford, or spend more money on improving safety features.

3. The homogeneity of goods, many wearable devices are very similar now, except for the brand is different, many functions are the same. For them, safety is just an additional function, they focus more on massage, phone calls or recording exercise data.In fact their design for safety is not comprehensive.