# Cornerstone Project Proposal

Use EEG signal monitoring system to warn disease outbreak in sleeping

**Yu Wang, Jialin Shao, Yutong Fu, Hongbin Zhang, Minyu Jiang**

**2016/1/17**

# Cornerstone Project Proposal

**Title:** *Use EEG signal monitoring system to warn disease outbreak in sleeping*

**Name**: *Yutong Fu, Hongbin Zhang, Minyu Jiang, Jialin Shao, Yu Wang*

**Mentor**: *Lijuan Duan, Juncheng Chen*

**Project Site**: *Computer (Electronic control type)*

## Personal Statement

In recent years, the demands for security, video surveillance and real time monitoring growing with the rapid development and wide application in banking, electric power, transportation, security and military installations, the study in this area also attracted an increasing number of research institutions and scholars ' attention. Along with the rapid development of the network, the monitoring system will be gradually come into the family. Through the study of this subject, our team is going to design a home monitoring system using for disabilities and old people, which can correspond to their abnormal behavior and feedback some emergency rescue. Thus our monitoring system can free family member who are not at home but afraid of the family situations, children and old people, to monitoring the situations happened in the house more relatively intelligent.

Our subject is based on Mindset, Android development technologies. We are going to design a home monitoring system, which can be afforded by ordinary-income families. As China gradually enters aging society, empty-nesters have aroused more and more concern. Older parents at home alone caught young people's concern. Through the study of this topic, those families with old and young people can have a more convenient means to ensure family safety.

## Objective

This project is aimed to develop a program, which can apply traditional sensor and EEG (electroencephalography) sensor to gather information about human and circumstance in real time, and do an early warning when any potential risk may do harm to the human body.

The program requires us to design a pattern which can transmit and recognize data. It will extract data from the sensors and have a comparison with the specific peaks stored in the database. According to the data, the program will monitor health condition and risk coefficient in the living environment for specific people.

This technology can be applied in monitoring myocardial infarction, shortness of breath, epilepsy and other symptoms. Also, it can be used to make an early warning. When the danger comes to happen, the program will inform the responsible people by alarm, text message and WeChat to offer a protection indoor to the infants and the elderly, which can decrease the frequency of the specific people's death in an unaccompanied situation.

## Background:

**Domestic Research Status:**

At present the domestic invention patent is: equipment of monitoring EEG in sleeping condition and its monitoring method

The patent outlines a device for detecting sleep EEG and monitoring methods of using EEG to monitor somatic function.

Another domestic system use EEG to monitor diseases: Smart epilepsy monitoring and alarm systems.

Smart epilepsy monitoring and alarm systems first get epilepsy patients database, then use LVQ (Learning Vector Quantization) neural network model to train and simulate in Matlab environment. The conclusion is: when the EEG shows in a high frequency wave γ (medically known as "spikes") and it's in large strength and repeated, the epileptic seizures easily.

Existing domestic research is at the preliminary development stage, only can use specific equipment under specific scenarios to apply its effect to specific people.

**Abroad Research Status:**

From the website under the US Department of Health hospitals (NIH) www.appliedclinicaltrialsonline.com we could learn from published articles that in hospitals the research for wearable technology has reached the level of clinical trials; however, the study of family and personal monitoring systems just stay at the level of ideas and researches.

There are already foreign companies which have introduced commercial operation. For example, "finger wear monitoring measure peripheral arterial tone (PAT)", this device is used to detect patient's vasodilation and also provide the appropriate calculation based on artery tension. Other monitoring devices of heart rate such as Apple watch can clearly record deep sleep and light sleep, summarize sleep time to help users monitor their sleep quality.

The above two types of testing equipment has also been a corresponding commercial software, you can reach to identify and distinguish the level of sleep stages, sleep quality to provide a summary of statistical data, but the relationship between sleep quality and the disease has not been in an accurate and direct feedback.

In summary, foreign institutes and commercial companies which work for wearable monitoring system already has many aspects of attempts, but there is little precedent for the direct monitoring of EEG. Such companies haven't take much time in analyzing the collected data and there is a little precedent of analyzing the EEG signals with the symptoms.

## Rationale:

**Social perspective:** During sleeping, the blood flow is slow and is prone to cause cardiovascular disease. To be able to detect such diseases and immediately notify their families and health care centers, we use early warning monitoring system with EEG to

warn suddenly disease attacks. The entire system is monitoring the changes of EEG in real time while people are in sleeping situation. Once the abnormal situation is about to happen, the system will notify their families and caregivers at the first time through mobile terminals with the fastest speed so that patients could receive treatment.

**Personal perspective:** During production process of the EEG monitoring system, we utilize brainwave knowledge acquisition technology, computer science, service science, biology, medicine, etc., with a strong interdisciplinary. In the process, we can not only learn a wide range of knowledge, but also be familiar with the design and practice engineering process, which sets firm foundation for our future Engineering Learning.

## Specific Aims

Our system aims to collect the real-time EEG (electroencephalogram) and heart rate signal, and analyze the possible dangers. When the sudden illness happens, our system will alarm and send the information to those who are related automatically by SMS (short message service) and Wechat.

**Aim 1:** Collect the real-time EEG (electroencephalogram) and heart rate signals.
Our system uses sensors and wireless transmission equipment to collect the real-time EEG (electroencephalogram) and heart rate signal. Firstly, the sensors part: (1) Mindset EEG (electroencephalogram) equipment (2) Heart rate bracelet (3) Wireless transmission equipment. Secondly, wireless transmission equipment part: (1) Control module (2) Storage module (3) display module (4) wireless receiving module (5) wireless transmitting module 1.

**Aim 2:** Analyze the possible dangers.
Our system uses web server to analyze the possible dangers. Web server part: (1) wireless transmitting module 2 (2) data analyzing module (3) database. We choose some typical sudden illness (epilepsies, cerebral infarction, etc.) and save the EEG (electroencephalogram) and heart rate signals of these illnesses into the database. By comparing the real-time EEG (electroencephalogram) and heart rate signals with the signals saved in the database, our system can analyze the possible dangers.

**Aim 3:** Alarm
When the real-time EEG (electroencephalogram) and heart rate signals are same as the signals saved in the database, which means the sudden illness happens, our system will alarm and send the information to those who related automatically by SMS (short message service) and Wechat.

## Project Approach

At the beginning of the project, our team need to learn some tasks about EEG. We'll

do analylsis about their project research approaches and conclude them. So that these can be reliable research support.

During the research of EEG, all team members should understand the fundamental information of EEG in detail and the operational approach of collecting and uploading the EEG signal.

Due to our project aims, we would like to put the EEG monitoring process into real life for specific people like the old and the disabled. Based on these, we ought to collect and handle the specific EEG signals of diseases for specific people. These diseases include myocardial infarction, disturbance in respiration and epilepsy. Characteristic EEG signal collected from this method can be saved as a database. After knowing the relevant information about EEG, all members will learn how to compare the collected signals to the specific signals in database.

In our experiment design process, we're likely to use the PERIOD method to enhance the operability of the experiment and increase the accuracy. Besides, it's easier to figure out which part is going wrong when catching a mistake and help improve it.

The following figure (shown in figure 1) is our basic idea. After the completeness of the sense process, wireless transmission and network server, we'll put these 3 processes together to form a system which can collect process and compare the EEG signals.
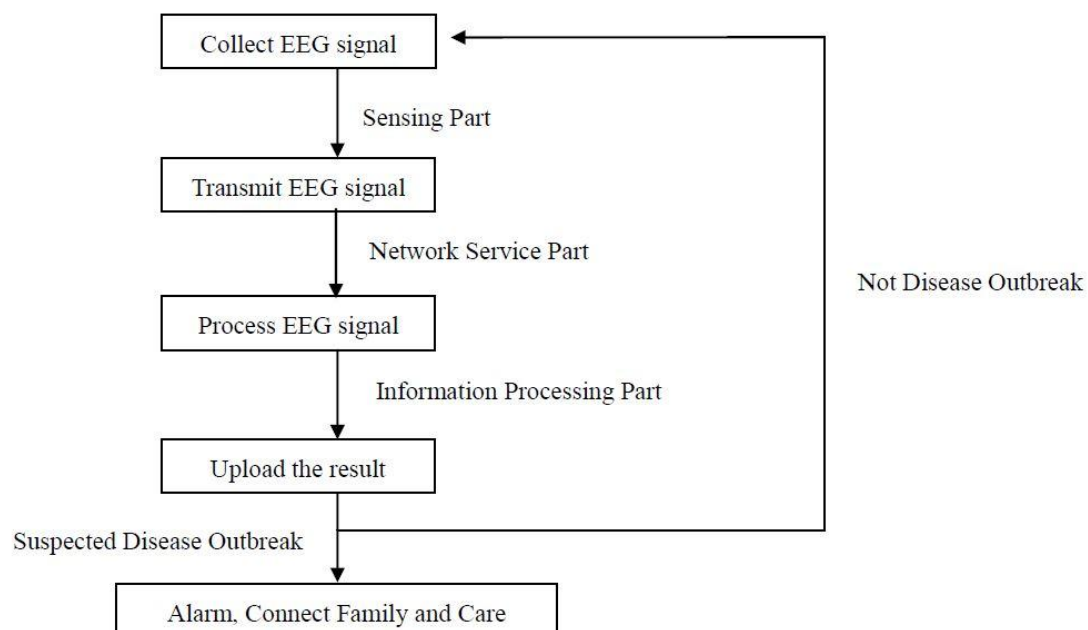


Figure 1-Process Figure

## Timeline

**2016.1 – 2016.3**: Learn JavaScript and Arduino. Make sensing part.

**2016.4 - 2016.6**: Collecting data. Making model. Build up database.

**2016.7 - 2016.7**: Initially set the wireless transmission of sensing part, wireless transmission part and network service part.

**2016.10 – 2016.11**: Do the repetition. Test the program and enhance. Complete alarm system.

**2016.12**: Conclude the whole project. Finish the final paper.

## Budget

| Item | Expense |
|---|---|
| Book | 1000 |
| Equipment in monitoring EEG | 4000 |
| Equipment in monitoring heart rate | 2000 |
| Electron and mechanical component | 3000 |
| TOTAL | 10000 |