

Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Invention)
(Word Limit: 1,000 words, Pages: 2 pages only)

Team Number: JAPE212

Project Title: HikeSafe (步報平安) – A life-saving pressure sensor insole with mobile app

Project Type: Invention

To our best knowledge and after thorough literature research, as at 30 / 06 / 2022, there are / are no* similar works. If there are, the reference links are as below:

The enhancement our project has made for the existing related products or research is summarized as below:

*Please delete if not applicable. HKSSPC values the originality of works. Students must conduct literature research thoroughly to ensure that their works are unique, and to list relevant reference materials to complement the research or invention.

I. Background

- Provide background information as to learn about the audience for whom the project is addressing
- Provide highlights of **literature review** and/or related technologies or devices, with the support of pertinent and reliable references
- Provide an overview of work, create a point of view as to define the needs and insights of the audience and mention the **research or technology gap the project is trying to fill**

Hiking has become one of the most popular leisure activities of HongKongers in recent years, but many hike alone and suffered mishaps. According to statistics of Hong Kong Police Force, there were at least 21 death and 124 injuries from hiking in Hong Kong in the first 9 months of 2020 (1). Some of these deaths could have been prevented if the affected hikers could be found within the golden hours for rescue.

Currently, there are pressure sensor insoles developed to detect the gait of users for rehabilitation purposes (2, 3), but their use as a tool to detect the well-being of the user in a hike or daily activity has not been explored. Of course, there are also smart watches and pedometer apps that detect the steps of a hiker, but these products merely record steps by arm swing frequency rather than actual steps. Most importantly, all the above lack the important functions of detecting sudden accidents of the user and emergency alert. Our invention aims to fill the research gap by inventing an app that can automatically alert the emergency contacts/relatives through the mobile phone when the hikers suffer from severe injury or acute disease could have prevented deaths.

References:

1. Oriental Daily News, 29 August 2020
2. https://www.researchgate.net/publication/328681609_Uncovering_the_Potential_of_the_Foot_as_a_Source_of_User_Information
3. https://www.researchgate.net/publication/281268373_An_Ambulatory_System_for_Gait_Monitoring_Based_on_Wireless_Sensorized_Insoles

II. Objectives

- State the **aim(s)** of project

The aim of this project is to develop an insole connected with an app that can:

- i) record and track user's activity during hiking
- ii) detect sudden injuries or accidents of the user during hiking
- iii) automatically alert the emergency contacts/relatives through mobile phone immediately at the time of the accident

iv) track the user's location through the GPS navigation signal so that it can readily detect when a user falls unconscious during a hike, and immediately send alert and correct GPS location to a preset emergency contact.

III. Methodology

- Briefly describe the **approaches** used e.g. use of equipment, materials, tests and experiments
- Explain the selected implementation strategies with the **scientific theory**

We propose to invent an insole with a pressure sensor connected with an app using the MIT app inventor. The pressure sensor detects pressure from the standing posture or walking movements of the user, and when connected to the app, pace analysis, steps and other parameters can be detected and recorded. Bluetooth will be used to connect the pressure sensor insole to the app.

. In the case of sudden injury or acute disease that leads to loss of consciousness, the user will fall to ground and the insole will no longer detect pressure signal. When pressure is not detected for a specified time, which can be set with the timer, the phone of the user will send out a notification signal through the phone app to alert emergency contacts of the user and help to locate the user via GPS position.

Building of the prototype:

Materials Used:

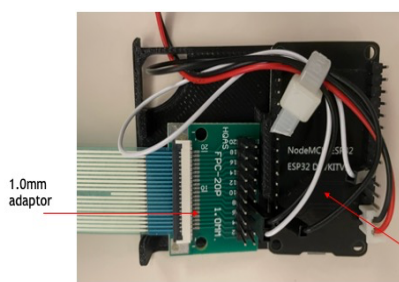
- Gorosa Film Foot Pressure Sensor - High Accuracy Pressure Sensor Flexible 16 Sensing Area IP67 Waterproof Sensing Mat Pressure Sensor
- Arduino ESP32 mini controller board -to read the pressure sensor inputs and turn it into an output on the app.
- Arduino Software - to write code and upload it to the mini controller board
- 1.0mm 20-port adaptor – to connect the pressure sensor the Arduino mini controller board
- MIT Invention App – for coding
- 3D printer – for printing the casing
- Insole

IV. Design of Invention

- Describe the **design** and the **principle** of invention (e.g. The ideation of the projects, the prototypes or creative solution as far as applicable)
- Provide sketches / drawings / photos of the invention

The HikeSafe insole consists of 2 major parts:

a). A pressure sensor that can accurately measure the steps of the user

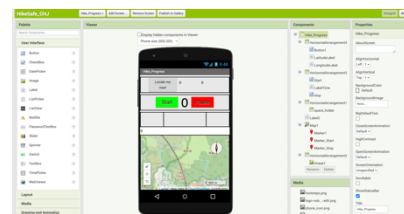


Assembly of hardware video demonstration

Arduino ESP32 mini controller board



pressure sensor connected to hardware casing



b). A mobile app connected through Bluetooth

The app will consist of:

1. A step-counter to calculate the number of steps
2. A stopwatch to record the time needed for the hike journey
3. An online map to show the hiker's exact location
4. An accelerometer sensor to detect sudden plunges or falls
5. A timer which only appears when the user is detected to be in emergency – when the timer countdown reaches 0, the app will automatically call and send SMS to the preset emergency contact.
6. Emergency call and SMS function

V. Application / Market Need

- Explain the area of **application** and function of invention
- Indicate the market need and impact of invention
- Discuss **limitation** and compare with existing related works (if any)

Potential Significance of the Invention:

To our knowledge, this is the first device designed to assist timely rescue to hikers caught in sudden accidents, by automatically detecting an accident emergency and then alerting their emergency contacts via SMS (and phone call) with their GPS locations. The application of this invention can be extended beyond hiking. Many fatalities occur because the injured are alone and left unnoticed, missing the golden time of rescue. This is particularly apparent in elderly living alone, or even in occupational settings where workers have to work in high-risk environments alone. The app can also be applicable in medical use to monitor the progress of rehabilitation in walking for those who are recovering from lower limb injury or stroke.

Challenges / Limitations of the Invention

Our app, developed through the MIT app inventor only supports android system (but not IOS). Moreover, MIT app inventor does not have an SMS sending function so we had to employ another platform, namely the IFTTT technology, an automation tool that enabled us to script SMS sending actions that link together a wide variety of devices and services. Finally, due to COVID restrictions, the progress of our invention has been significantly hindered. We had very little time to gather as a full team to work face to face to build the prototype and perform rigorous testing. This led to some constraints of the product, such as minor bugs in the app which requires further enhancements.

VI. Conclusion

- Make a **data-driven** conclusion of the project and the way forward of the invention process
- Justify if the proposed project meets the objective(s)

In this project, we fulfilled our objectives through the development of a life-saving mobile app connected with a pressure sensor insole that can readily detect sudden accident of the user, and automatically notify the pre-set emergency contact via SMS or call, and provide the user's accurate location. This enables the user's family to immediately seek rescue and locate the user in the critical first few hours after the injury or acute illness.

Going forward, we aim to refine the invention to achieve higher speed sensing and quicker response in the pressure sensor. We will also incorporate the use of FireChat to ensure that the app can call / send SMS in places without mobile reception/signal.

Our project is developed based on our school's previous project and the enhancement is as below: