Applications of RFID: A Case Study of the Protective Device for Mobility Aid

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Abstract—The term mobility aid used in this study refers to wheelchairs for disabled people. This product was designed with RFID technology to send and receive signals through processors. The protective device utilizes sound alarm and warning lights and is combined with fan-shaped or fence-type shutter gates as shields. The RFID device can be fixed to the wheelchair or temporarily attached to the permit, so that when the disabled person gets close to staircases or danger zones, the protective device installed would send off alarms and lights as a warning. If he continues to move toward that area and gets inside the default range of danger, the shield guard is activated to prevent the person from falling down the staircase or stumbling into the danger zone, thus ensuring his safety.

Index Terms—RFID, mobility aid, protective device, danger zone, staircase

I. INTRODUCTION

The disabled are limited in their movement and can hardly control the situation around them. Sometimes, due to momentary carelessness, they do not see the road condition ahead and could fall down the staircase or stumble into danger zone, usually resulting in serious injuries. This study believes that creating a barrier-free environment to ensure the safety of those with limited mobility and their convenience is an urgent issue.

This study proposed a protective device to prevent those on wheelchair from falling down the staircase or entering a dangerous area. When the wheelchair gets near the stairs or danger zone, the installed RFID technology would send and receive signals then give off sound and light alarms as warning. If the person gets closer and reaches the default danger range, the system would automatically trigger the shield guard to prevent possible accidents.

This creative invention can be easily installed on existing spaces and is not limited by brands or models of wheelchairs used as mobility aids. Regular users can install a fixed radio transmitter on their wheelchair, while temporary users can affix the wireless radio transmitter on their permit for the purposes of receiving warning and protection.

II. LITERATURE REVIEW

Radio Frequency Identification (RFID) is an internet of things technology that provides many benefits to the healthcare industry’s supply chain. However, a challenge faced by the healthcare industry is the limited adoption and use of RFID by physicians and nurses [1]. Some medical systems have applied RFID in tracking down patients to ensure their safety [2]. A recent study suggested that RFID is indeed a technology which can improve the current conditions of users [3].

There have been plenty of studies regarding wheelchairs as mobility aid. A recent study performed computer simulations and tests in relation to the wheelchair users’ behavior in aircrafts, in hopes of increasing user convenience and reducing user costs [4]. Another study conducted tests and trainings of mobile skills such as going forward, backward, and turning on wheelchair users, in hopes of increasing user confidence [5]. Of course, the safety and comfort of the users’ head, neck, and cervical vertebra are also very important and were put into consideration [6]. Moreover, for those who can operate a wheelchair with only one hand, special functions for wheelchairs must be designed and corresponding trainings be provided [7].

According to related literature, with the innovation and increasing popularity of the RFID technology, wheelchairs are being designed in a more humane way with more complete functions to help users move around safer and more conveniently [8], [9]. So far, RFID technology has not yet been applied to wheelchairs to meet user demands. Thus, this study aims to investigate this issue.

III. CREATIVE DESIGN

This study applied the RFID technology in the design of a protective device. The chip is installed on the wheelchair or the permit for the disabled. When a disabled person goes near a staircase or danger zone, the device would alert him with alarms and flashing light to remind him to be careful. If he gets closer and goes inside the default danger zone, the system would initiate the shield guard to ensure his safety.

The idea for this innovative invention was generated as the creator personally witnessed in the workplace and
read in newspapers or magazines about horrible accidents of wheelchair users falling down staircases or stumbling into danger zones due to frolicking or carelessness. Therefore, a protective device that can prevent mobility aids from getting near stairs or dangerous areas was designed. It sends out a warning when a mobility aid draws near the danger zone. If the wheelchair gets closer, the shield guard would be triggered in order to prevent accidents from happening to the disabled.

This study actualized the creative idea and not only filed for the R.O.C. utility patent application but also participated in the International Engineering Invention and Innovation Exhibition (i-ENVEX). i-ENVEX was hosted by Universiti Malaysia Perlis (UniMAP). The department of design in this university is very famous. Its graduates are highly sought after by companies in Malaysia and Singapore, and many of them have also continued their study in the UK. This international exhibition was very suitable for the participation of students under the guidance of their mentors. Students from all over the world were present in the exhibition, and they could exchange their views and experiences with one another. Furthermore, by joining such international competition, students could be trained to promote creative inventions and improve their ability of expression using a foreign language.

Moreover, the target participants of i-ENVEX are mainly students from elementary schools, high schools, vocational schools, universities, and graduate schools, aged 6 to 25. Its purpose is to develop an atmosphere of research and invention among students, in hopes that they can invent products based on what they have learned in school. i-ENVEX is a stage for young creators and scientists where they can present and share their creative ideas. It also offers good opportunities of exposure to newly invented technologies from various fields and attracts the participation of related companies to build business relationships.

IV. DESIGN RESULTS

To prevent wheelchair users from falling down staircases or danger zone entrance due to carelessness or poor vision, this study designed a fixed/temporary sensor device using RFID technology which can be installed on the wheelchair or inserted into the permit, combined with a shield guard, to ensure the safety of the disabled. Fig. 1 shows that the invention has already received the R. O. C. invention patent. Fig. 2 shows the appearance of the innovative product, Fig. 3 the a temporary pass worn by a person, and Fig. 4 and Fig. 5 the simulation of the shield guard being activated, with two different forms of shutter gates, fan-shaped or fence-type, respectively. In addition, this product won the gold prize (Fig. 6) and the Malaysia special award (Fig. 7) in i-ENVEX. Fig. 8 and Fig. 9 present the competition scenes, and Fig. 10 shows the reception of the award.
V. CONCLUSIONS

This design is a protective device used to prevent people using mobility aids from entering a danger zone. It can be installed near staircases or the entrance of a dangerous area as a reminder and protective measure. When a wheelchair comes close, a warning will be triggered. If the wheelchair still continues to move toward the area, the shield guard will be activated to block the entrance in order to avoid possible accidents. The general features of the product based on the innovative R&D idea of this study are summarized and illustrated below:

1) Careful observation
The creator came up with this creative idea from daily life observations as he had seen wheelchair users carelessly fall down staircases or into danger zones, usually resulting in serious injuries.

2) Creative idea
Users’ needs and convenience are taken into consideration. This innovative design is composed of a fixed or temporary RFID sensor which can be installed on the wheelchair to send out and receive signals, a warning device with alarms and flashes, and a safety shield guard.

3) Care for the disabled
The main consideration of this study is the safety of the disabled. Thus, the creative design was carried out in the simplest way with the purpose of keeping the disabled safe while moving.

4) Low developmental cost
The creative design is based on the installation of an RFID sensor. The developmental cost is low, and the product is easy to manufacture and apply; thus, it has very high market potential.

REFERENCES


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