Faculty of Computer Science and Information Technology

ASSISTED NAVIGATION AND OBJECT DETECTION FOR BLIND PERSON USING DEEP LEARNING

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NAVIGASI DAN DETEKSI OBJEK UNTUK ORANG BUTA DENGAN APLIKASI DEEP LEARNING

LIM YI SWEN

Projek ini merupakan salah satu keperluan untuk

Ijazah Sarjana Muda Sains Komputer dan Teknologi Maklumat

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ABSTRACT

For blind people, navigation and recognizing objects are activities which are challenging due to their disability. Therefore, their quality of life is affected to some extend and in situation where they encounter a new environment, it might contain harmful objects. The traditional methods to assist blind people to navigate such as walking stick and guide dog do provide some assistance to some extent but still does not provide accurate information to the blind person. There is also technology assisted navigation approach such using sensors and so on, but it does not provide actual information about the objects in the environment to the blind person. Therefore, this project proposed an assisted navigation and object detection solution using deep learning approach on a low-cost single board computer to allow the recognition to be done on the site itself without relying on external Internet/network connection. This project promotes a low-cost, portable, scalable and edge computing solution. It is expected that the proposed solution will enable the blind people to navigate and detect objects and improve their quality of life.

ABSTRAK

Bagi orang buta, navigasi dan pengenalan objek adalah aktiviti yang mencabar kerana ketidakupayaan mereka. Oleh itu, kualiti hidup mereka terpengaruh dengan beberapa cabaran dalam kehidupan harian mereka. Khususnya, dalam keadaan di mana mereka berada di persekitaran baru, ia mungkin mengandungi objek yang berbahaya. Kaedah tradisional untuk membantu orang buta untuk menavigasi seperti tongkat dan anjing pemandu memberikan bantuan dalam kehidupan mereka, tetapi kaedah-kaedah ini mempunyai batasan. Kaedah-kaedah tradisional ini tidak mempunyai kebolehan untuk memberikan maklumat yang tepat kepada orang buta. Terdapat juga alat navigasi bantuan teknologi seperti menggunakan sensor dan sebagainya, tetapi ia tidak memberikan maklumat yang tepat mengenai objek dalam alam sekitar kepada orang buta. Oleh itu, projek ini mencadangkan ANOD sistem yang menggunakan pembelajaran mendalam pada komputer papan tunggal dengan kos rendah yang mempunyai kebolehan untuk mengenal sesuatu objek di persekitaran. Proses pengenalan objek ini juga dijalankan dalam komputer papan tunggal ini tanpa bergantung pada sambungan Internet. Diharapkan penyelesaian yang dicadangkan ini dapat membantu orang buta dalam menavigasi, mengesan objek dan meningkatkan kualiti hidup mereka.

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LIST OF ABBREVIATIONS

ANOD	Assisted Navigation and Object Detection
RPI	Raspberry Pi
GPIO	General Purpose Input Output of Raspberry Pi
SSB	Sarawak Society for the Blind
SSID	Service Set Identifier
FPS	Frame Per Second

CHAPTER 1: INTRODUCTION

1.1 Background

According to World Health Organization (2018), there is around 1.3 billion people with vision impairment worldwide which 36 million of them are blind and 217 million of them have moderate to severe vision impairment. Blind or vision impairment persons usually have a difficult time with their normal daily activities such as navigate outside the spaces that they are accustomed to which is a completely new or unfamiliar environment for them. In a new environment, blind peoples may not easily know the position of object and can barely navigate in the unfamiliar environment.

Nowadays, blind people navigate around the places rely on the traditional navigation aids such as guide dogs and white canes. However, there are many limitations for these two approaches. White cane has several significant drawbacks for blinds to navigate like limited preview range and risk of hurting by unforeseen hanging obstacles which are not on the ground. In the other hand, guide dogs are difficult for blind peoples to understand the complex direction of these dog and they are only suitable for about five years. The limitations of traditional navigation approaches led to the needs of development of assistive technological tools that can aids blind peoples in object detection as well as providing the required navigation.

In recent years, there are many researcher and innovator are also working on assistive smart tools to help blind people in object detection and navigation. There are few significant assistive smart tools for visually impaired people that had presented in the international scientific literature like BAWA cane, Smart Cane, Real-Time Visual Recognition with Results Converted to 3D Audio system and so forth. The significant drawback of these few existing tools for blind person is the accuracy in detection of object and the portability of the tools.

Therefore, a system that can assist blind persons to detect object and navigation is needed to be developed. The project outcome is expected to be a system that can help blind peoples to identify objects and provide voice navigation to aids them in their daily activity.

1.2 Problem Statement

Conventional method of navigation is limited, danger and not safe: Nowadays, blind peoples identify or recognize object using all their senses including hearing, smell and touch. Blind people also navigate with the utilization of traditional approaches such as guide dogs and white canes. However, blind peoples may still face difficulties in recognizing object and navigation in the new environment. The constraints of detecting object using senses and those tools is relevantly slow, limited in identifying objects correctly, and not safe when comes to identify sharp object.

Lack of existing assistive technological tools for blind people to do object detection and navigation: There is lack of existing technological tools to help blind peoples to navigate and identify object in new environment. Therefore, there are no warning when comes to identify sharp or other dangerous object that may harm blinds people or cause accidents to happen.

Lack of assisted voice navigation system to detect object and to navigate: Due to lack of devices and systems to provide voice navigation to identify object and to navigate, the blind peoples usually will use guide dogs to aid them in movement by navigating around the places to alert them to change direction. However, there is limitation whereby this approach is difficult for blind peoples to understand the complex direction of these dog and they are only suitable for about five years.

1.3 Objectives

The main aim of this project is to design and develop a system which able to provide object detection and assisted navigation for a blind person. The objective towards to accomplish the aim are

- To identify object in the new environment using deep learning approach.
- To provide voice navigation on the object detected and voice warning alert if there is harmful object in the environment.

1.4 Methodology

The methodology that will be uses in this project is Rapid Application Development (RAD). Rapid Application Development is a methodology that delivered product rapidly, it also allowed the product implemented in working environment within a limited time constraint (Daud, Bakar, & Rusli, 2010). This model is most suitable for this assisted navigation and object detection system as rapid application development can adapt to changing requirements during development phase.

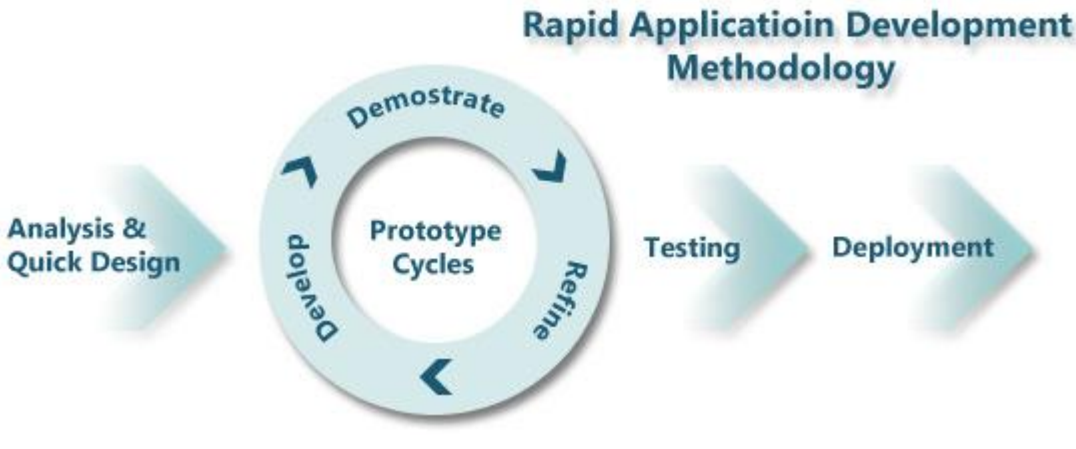

Figure 1.1 Visualization of RAD development lifecycle (Abd Ghadas, Z. A., Wan Ismail, W. N., Abd Aziz, A., Harun, N. A., Jusop, M. & Abd Rahman, C. A. ,2015)

1.4.1 Analysis and Quick Design Phase

In the analysis phase, requirement elicitation needs to be facilitated to discovering the needs of the blind or visionally impaired persons. In this case, a one-to-many interview is most suitable as this allow more in-depth information collection from the interviewee. Quick design can be done after the requirement analysis is done. The physical design can be sketch based on the requirement gathered.

1.4.2 Prototyping Phase

In the prototyping phase, a prototype is first build based on the design. Once the prototype is built, it can proceed to demonstration and getting feedbacks from the blinds peoples and refine it accordingly.

1.4.3 Testing

After the prototype is refined to its requirements and appropriate properties, it can proceed to the testing phase. In the testing phase, it can be break down into smaller tasks that is preparation for rapid construction, program and application development, coding and unit, integration, and system testing.

1.4.4 Development

The last phase which is also known as the implementation phase allowed the launching of the finished product which it also includes the data conversion, testing and changeover of the system.

1.5 Scope

The scope of the project has been outlined and listed as below:

i. The Assisted Navigation and Object Detection for Blind Person system is designed to be adapted in a controlled environment.

ii. The data collection in this system will only include the date, objects, mode and the probability of the prediction.

iii. This system will focus on two major components, namely object recognition and assisted voice navigation. The object recognition function will integrate Google TensorFlow Object Detection API in a Raspberry Pi.

iv. The video taken for object detection will not be stored in database as it is not necessarily in this project.

v. The position estimation of the object detected will not be implemented in this project as the amount of time required to implement this feature is not feasible within the limited time of the project duration. Besides, it needs additional sensor which might increase the weight and space to the whole setup of the system.

vi. The objects are required to be captured by the camera in order to be processed by the object detection function. In order to have a better object recognition, the object captured by the raspberry pi camera must within the view of the camera.

1.6 Significant of project

The significance of the project is to build a system that can assist blind or visually impaired person to detect object safely and provide voice navigation in a new environment. The purpose of object detection function in the system is to provide a precise detection of object in a new environment and a safer approach in recognizing an object. Next is the voice assisted navigation function which is very helpful when comes to navigate the blind and visually impaired person in recognition of object. These functions can help blind peoples better explore the surrounding environment and performed accurate real time object detection.

1.7 Project Schedule

The project schedule of this project starts from 10th September 2018 until 20th May 2019. The project schedule is constructed using Gantt chart as shown in Appendix A.

1.8 Expected outcome

The Assisted Navigation and Object Detection for Blind Person system is built to provide object detection and assisted voice navigation for better exploring in a surrounding environment. This system should be able to identify object in the new environment. Furthermore, it should be able to provide voice warning if it detects harmful object in the new environment to ensure the safeties of blind person during the process of object detection. Finally, the system must be able to provide voice navigation for blind people to navigate around unfamiliar places. The system will assist the blinds to travelling around new environment and to get a greater independence.