Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF VOICE-ASSISTED SURVEILLANCE SYSTEM FOR VISUALLY IMPAIRED PERSON USING SINGLE-BOARD COMPUTER

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Bachelor of Computer Engineering Technology (Computer Systems) with Honours

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I declare that this project report entitled "Development of Voice-Assisted Surveillance System for Visually Impaired Using Single-Board Computer**"** is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : *Firhad*

Student Name : MOHAMMAD FIRHAD BAKAR

Date : 15 January 2023

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DEDICATION

To my beloved family, partner and friends for their invaluable guidance, encouragement, and support throughout my journey. Their wisdom and insight has been instrumental in shaping my professional development and personal growth. I am deeply grateful for the time they have dedicated to me and the countless lessons they have taught me. This dedication is a small token of my appreciation for everything they have done for me, and a testament to the profound impact they have had on my life.

ABSTRACT

The purpose of home security is to ensure our safety at home. In the absence of auditory or physical contact, the visually impaired homeowner is limited to recognizing known people in their home, which puts their safety at risk. So, the main objective of this project is to develop a home surveillance system that can recognize predetermined faces and inform the visually impaired owner via an audio signal. The system also allows the visually impaired homeowner to access and operate the programmed device without the need for visual clues since users are guided through the application by a voice assistant. The flow of this project is images are been identified from a single-board computer through the camera that sends information to the Android application. Android Studio is to design the user interface for people with the visually impaired along with the command person's name. HAAR classified applies for face detection to execute several algorithms that process recognition. Firebase is a database where the information will be collected from both devices and the Raspberry Pi is used as a central processing unit for a variety of projects and applications. This project focuses on face recognition, voice assistant, and home automation.

Keyword: security, visually impaired, surveillance, face recognition, audio signal, voice assistant.

ABSTRAK

Tujuan utama keselamatan rumah ialah untuk memastikan keadaan keselamatan sejagat di kawasan rumah. Tanpa adanya sentuhan pendengaran atau fizikal, orang yang kurang jelas penglihatan menghadapi penglihatan yang terhad di kawasan perumahan meraka, ini juga membahayakan keselematan mereka. Objektif utama projek ini adalah untuk membangunkan sistem kawasan perumahan yang boleh mengecam muka yang telah ditetapkan dan akan beri maklumat kepada pemilik terjejas penglihatan melalui isyarat audio. Sistem ini juga membenarkan pemilik rumah terjejas penglihatan untuk mengakses dan mengendalikan peranti yang diprogramkan tanpa memerlukan petunjuk visual memandangkan pengguna dibimbing melalui aplikasi oleh pembantu suara. Pengaliran sistem ini dimana gambar yang diperoleh dari komputer papan tunggal melalui camera akan menghantar maklumat ke aplikasi Android kemudian mengeluarkan suara untuk penama. HAAR kelas digunakan untuk mengimbas muka untuk dilaksanakan sebahagian algoritma untuk pengesahan dan juga Raspberry Pi digunakan sebagai unit pemprosesan pusat untuk pelbagai projek dan aplikasi. Tujuan utama projek ini untuk pengesahan muka, pembantu suara, dan automasi rumah.

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In the Name of Allah, the Most Merciful, the Most Compassionate, Alhamdulillah all praises belongs to Almighty Allah, the Lord of the worlds and prayers and peace be upon Muhammad His servant and messenger.

I would like to express my sincere gratitude to myself who have supported me throughout the journey of this project. The countless hours of research, the late nights and early mornings, the brainstorming sessions and the problem solving, all of it has paid off in the end.

I would like to acknowledge the unwavering support of my family, friends and colleagues who have provided me with the encouragement and motivation to pursue this endeavour.

I am also grateful to my professors and mentors who have provided me with the knowledge and guidance that was essential in completing this project. I would also like to acknowledge the support of the organizations, who provided me with the resources and facilities necessary to complete this project.

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INTRODUCTION

This chapter will study about the background of the project, problem statement, objectives, scope of the project, and the project outline.

1.1 Research Background

Blindness and vision impairment impact 37 million and 124 million people globally, respectively, according to the World Health Organization [1]. Many visually impaired people face lots of difficulties doing some tasks in daily life. According to studies, the disability of visual might affect a person's quality of life by limiting social interactions and interdependence along with security in their surroundings [2]. Protecting privacy, security, and safety in both the actual and virtual worlds are key issues that practically everyone encounters. However, for other groups, such as the visually impaired, these issues are particularly severe. Even though there are several types of tools available to overcome these challenges, they are still not sufficient because they require an external assistant

Throughout these studies, implementing a voice-assisted surveillance system probably could help them interact with people around them. The internet and user interface are blind to the visually impaired, but to avoid this, provide an end-to-end voice-based software solution for the visually impaired that allows them to use the devices with minimum to no keystrokes. Instead of utilizing a keyboard, the user will click the button to speak the orders to make them acknowledge the actions. The program then converts the text-to-speech, which will be the command to be performed based on the Android application.

1.2 Problem statement

Sight and vision are vital because they provide us with beauty and knowledge of the world. They also protect us from any consequences. Both views work together to aware of the hazards. The person's vision assists them in recognizing the meaning of the situation and jumping to conclusions. They tend to get more risks than other normal people. Having to struggle to recognize mankind is probably one of the primary challenges for people with visual impairment. Home is not a safe place if a lacks security which could be dangerous when no monitoring system can notify them.

Figure 1 Visual impaired sight [3]

To overcome this issue, face recognition is one of the ways as an external assistant to verify or identify the subject image, video, or audio-visual aspect of faces. Detecting the face would make the software analyze the structure of faces and convert the image into data. In terms of adding the speech or voice assistant makes the user easier to know the actual subject and give the information through audio signals.

1.3 Project Objective

The main objective for this project:

1. To develop a mobile application based on a surveillance monitoring system using a single-board computer.
2. To develop a home automation application that controls several devices using internet access.
3. To implement voice assistance features for visual impaired person.
4. To perform validation and verification of the surveillance monitoring tools and home automation

1.4 Scope of Project

The scope of this project focuses on using a single-board computer and Android application to implement face recognition, voice assistant, and system surveillance which allows visually impaired people to communicate with devices. The appearance of face recognition and system surveillance will be able to detect the person and surroundings. In addition, the single board as a core, by installing the Android application on the phone, voice commands may be delivered from the phone. The single-board computer is connected to the mobile device through a cloud database. The single-board computer receives these commands and processes them based on the apps. The smartphone will notify if there is any presence of humans around them if the camera detected the face by using a voice assistant.

1.4 Project Outline

This report is divided into five chapters that detail the “Development of voice assisted surveillance system for the visually impaired person using single-board computer” project's implementation.

The background of the development of the voice-assisted surveillance system for the visually impaired person using a single-board computer is presented in the first chapter. A problem statement is given, along with a list of objectives to be met in

order to address the difficulties. This chapter discusses the study scope and project outline.

The literature review is based on the second chapter. This section contains a discussion of relevant research conducted by researchers based on the project's implementation and functionality. A comparison of the projects is carried out in order to determine the fundamental concept and theory, and offer a wide picture of the essence of execution that will be suitable for this research.

The methodology to execute this project is detailed in the third chapter. The approach is accomplished by following a set of procedures to build this project while adhering to the given objectives. In addition, a flowchart is created to show how this project system works in its entirety.

The specifics of the outcomes acquired from the performance of this project are presented in the fourth chapter. In addition, in this chapter, the discussion of the analysis based on the project's outcomes and discoveries is clearly finished.

The final chapter essentially wraps up and highlights the important points, as well as determines if the project's output met the stated goals. Finally, there will be a part in this chapter that provides recommendations for future improvements to this project using emerging technologies.

LITERATURE REVIEW

This is the literature review of the studies and research based on the important information and details for this project was gathered from many resources such as articles, journals, books, and the internet regarding the related previous study. Hence, this chapter's studies begin with a surveillance system using face recognition, and the audio signal. It is essential to carry out this study on these topics because they are the project's primary purpose. Besides that, the medium of this project involves single-board computer technology which is important to learn the principles of technology to have a clear view of the scope.

2.1 Introduction

Generally, a surveillance system consists of a camera system, monitors or display devices. Cameras come with a wide range of design options such as analog or digital. This system can be used at a structure or property either in indoors or outdoors. To record all of the time, only record in reaction to movement, or only record at specified times of the day can be programmed by the system.

According to [4] object detection, face recognition, and face identification are a combination of multiple techniques that the surveillance system technologies can implement in order to identify intruders and monitor target regions. Face recognition has received a lot of interest because of its various uses in confidential information, security policy enforcement, and inspection.

Sector	Applying
Security	Access Control. Boarding system. Workstation access.
Law Enforcement	Forensics. Analysis.
Database Investigation	National Identity Document. Vehicles Registration. Licensed drivers.
Inspection	Monitoring CCTV Portal control

Table 1 Face recognition application [5]

Figure 2 Surveillance system devices [6]

2.2 Face Recognition

Face recognition is a vision system capability for identifying people based on their facial features. Other than that, it will provide information when determining a human face presence belonging to the size, position, and location of each facial structure. To discover face identity, the face is retrieved and compared to a known face detection when the identity characteristic appears [7]. Furthermore, there are several components of facial recognition in the following sequence which are image collecting, image pre-processing, feature extraction, matching, and combining will be integrated with hardware cameras and computing devices.

2.2.1 OpenCV HAAR Cascade Classifier Algorithm

OpenCV or known as Open-Source Computer Vision Library often uses HAAR cascade classifier for human face detection. This technique was first presented by [8]. The given image is inserted to determine features by HAAR. The sum of pixels under the black rectangle will be subtracted the sum of the pixels under the white rectangle is calculated to derive a single value for each feature.

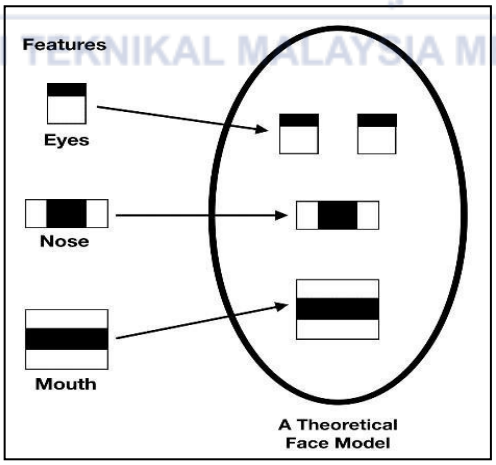

Figure 3 HAAR features [9]

The HAAR features begin the checking image for the detection of the face starting from the top left corner until the end of the face from the bottom right corner in the image. There is the calculation for every pixel as shown in (1).

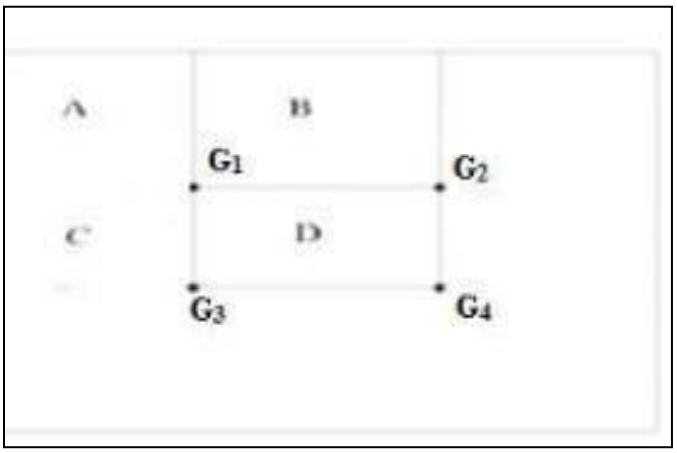

Figure 4 Diagram of HAAR features [8]

The Viola-Jones method begins analyzing these attributes in the provided picture with a base window size of 24x24. All potential HAAR feature properties could be unrealistic to count 160,000 and above features in the window regarding the properties such as location, scale, and type.

As a result, the AdaBoost algorithm would be the solution to overcome this issue. AdaBoost is a machine learning method capable of identifying the best features. This kind of method gathered some of the weak learners into the strong learners.