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Talking Smart glasses for the blind people

Presented by:

- **Khemis Houda**
- **Beldjehem Ryene**

Framed by:

CHEIKH MOHAMED

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Thanks

We first thank “god” who gave us courage, will strength and patience in order to develop this thesis (hamdolillah) we very much thank our supervisor *Chikh Mohamed* for accepting to direct and supervise this work, for his precious advice which facilitated our research.

Dedicate

I thank god for giving me the courage to accomplish this humble work that I dedicate:

To my dear parents

Who are the candle that illuminates my life with their advice, sacrifice, support and prayers throughout my studies.

For those I love so much and who supported me throughout this project:

My husband *Mohamed Lamine*

And of course

My sisters *Moufida, Fatiha, Houria and Afef*

My brothers *Adel and Hicham*

To my best friend *Ryene* and

To all my friends

And **all my big family**

L.Houda

Dedicate

I dedicate this project:

To my dear Mother

To my dear Father

Who never ceased to formulate prayers for me, to support me so that I can achieve my goals.

To my brothers *Choukri* and *Zine El abidine*

To my sisters *Imane* and *Meriem*

To my brother's wife *Besma*

For their moral support and their invaluable advice throughout my studies

To my little family's boys

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Who helped me a lot through difficult times

To my colleague *Houda*

Who worked so hard with me to complete this project

To my dear friends *Warda, Rania, Ahlem*

For their help and support in difficult times

To all my family.

Ryene.H

Abstract:

In a world dominated by the darkness of modern technology and in which speed hurricanes prevailed, reading has always been a torch that illuminates the path of success; Many people have suffered from its loss, whether they are illiterate due to wars and proverty, or the visually impaired and the blind due to diseases: Myopia, farsightedness, astigmatism, presbyopia…etc.

This project aims to develop smart talking glasses using Arduino tools that help this category of people to read books and magazines or even read from electronic devices, and also facilitate movement for the blind, such as reading signs and others. So the camera takes a picture and send it to the phone to be processed, extract the text from it, and then convert it into voice.

Keywords: Smart glasses, Blind, Arduino, Android.

Résumé:

Dans un monde dominé par les ténèbres de la technologie moderne et ou prédominaient les ouragans de vitesse, la lecture a toujours été une torche qui éclaire les chemins des esprits haut de gamme et les guide vers le chemin du succès ; Des nombreuses personnes ont souffert de sa perte, qu'ils soient analphabètes à cause des guerres et de la pauvreté, ou malvoyants et aveugles à cause de maladies : Myopie, Hypermétropie, astigmatisme, presbytie… etc.

Ce projet vise à développer une lunette parlante intelligente à l'aide d'outils Arduino qui aident ce catégorie de personnes à lire des livres et des magazines ou même à lire à partir d'appareils électroniques, et facilitent également les mouvements pour les aveugles, comme la lecture de panneaux et autres, de sorte que le caméra prenne une photo et que l'envoyiez au téléphone pour le traitement, extrayez-en le texte, puis convertissez-le en audio.

Mots clé : lunette intelligente, Aveugles, Arduino, Android.

ملخص:

في عالم غلب عليه ظلام التكنولوجيا الحديثة وسادت فيه أعاصير السرعة ما تزال القراءة مند الأزل شعلة تنير دروب العقول الراقية وترشدهم نحو سكة النجاحات... لقد عانى الكثير من الناس من فقدانها، سواء الأميين بسبب الحروب والفقر، أو ضعاف البصر والمكفوفين بسبب الأمراض: قصر النظر، مد البصر، اللابؤرية، طول النظر الشيخوخي... الخ

يهدف هدا المشروع إلى تطوير نظارات ذكية متكلمة باستعما ل أدوات الاردوينو تساعد ها ته الفئة من الناس على قراءة الكتب والمجلات أو حتى القراءة من الأجهزة الالكتروني ة، وأيضا تسهيل التنقل لدى المكفوفين كقراءتها ل اللافتات و غيرها. بحيث تلتقط الكاميرا صورة و ترسلها إلى تطبيق اندرويد ليتم معالجتها و استخراج النص منها و تحويلها إلى صوت.

الكلمات المفتاحية: نظارة ذكية ، المكفوفين، اردوينو، اندرويد .

Summary:

General introduction

Chapter I: Human vision

Chapter II: Pattern recognition and extracting objects from images

Chapter III: Conception and implementation

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Bibliography

List of abbreviations:

OCR: Optical Character Recognition.

BT: Bluetooth.

ML Kit: Machine Learning Kit

IDE: Integrated Development Environment.

USB: Universal Serial Bus.

WHO: World Health Organization.

ORcam: Optical Recognition camera

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Chapter I:

General Introduction

General introduction:

The blind people are an insignificant segment and an integral part of society; among them are the talented, the creative, and the strugglers who were forced by fate to live life captive, of darkness.

Globally, more than one billion people live with visual impairment because they do not receive the care they need for conditions such as nearsightedness, presbyopia, glaucoma or cataracts. This is the finding of first global vision report published by the World Health Organization. [A]

People with visual impairments, especially blind people, have specific problems not only in mobility but also in reading books, newspapers, magazines and signs as well as electronic boards, food menus, etc... And suffer from this problem also illiterate people who cannot read.

Technological progress has contributed to the development of some devices to assist the blind in reading, such as Braille, but these devices cannot be used in all cases.

Our project aims to design smart glasses consisting of tools and components that allow us to create different functions in our glasses.

This memorandum consists of three chapters where:

In the first chapter we will present the function of the eye, visual problems and their causes and the suffering of the blind people, and we will also discuss about illiteracy and its causes.

In the second chapter, we will talk about some of the devices developed to identify patterns.

As for the third chapter, it consists of two parts:

The first part will explain the work and function of the smart glasses.

As for the second part, we will present the tools used to design these glasses, as well as the programming.

Chapter I:

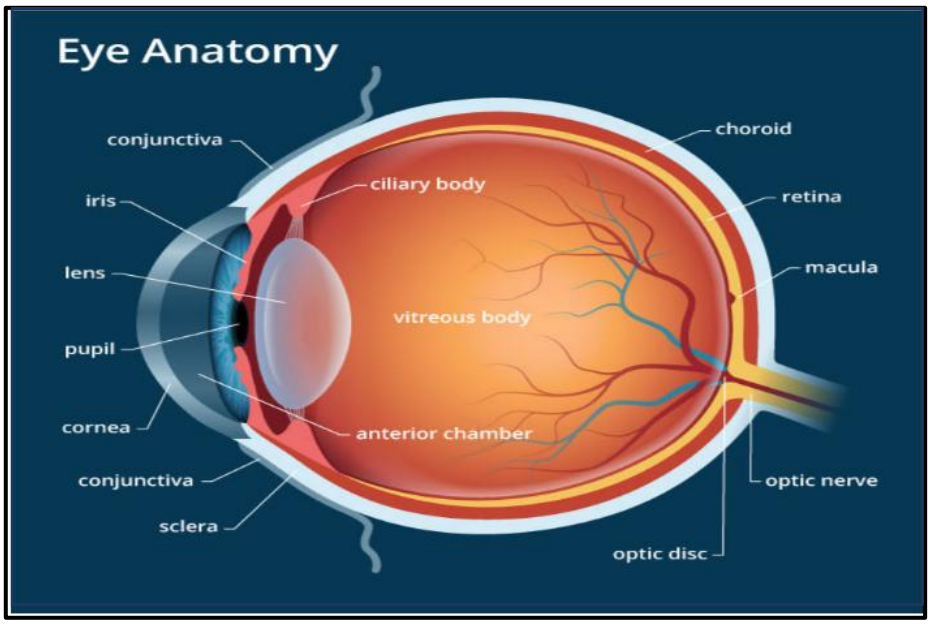
Human vision

I.1. Introduction

In this chapter at the beginning we are interested in the medical aspect of our theme, we will talk about visual blindness, we will also present the difficulties encountered by blind and visually impaired people in daily life, as well as the technical aids available on the market.

I.2. Eye anatomy:

The eye is a globe about 24 mm in diameter, the thickness of its wall is around 0.5 to 1.5 mm housed in the orbit, the eyeball is provided with muscles intended to direct the gaze and protected by the eyelid.



FigureI.01: eye anatomy

The eye is enveloped in three (03) membranes, from the outside to the inside we distinguish:

1. The cornea: The outer envelope is a fibrous membrane, the sclera (or white of the eye) which ensures a effective protection. This membrane becomes transparent and curved at the front.

2. The uvea, or middle tunic, forms the choroid, the nourishing tissue of the eye, at the back, and the diaphragm iris in front, pierced in its center, the pigments of which give the eye its color. In the center of the iris is the pupil, a black orifice, which expands or contracts

depending on the light. The ciliary body located at the junction of the iris and the choroid secretes the aqueous hum or.

3. The retina constitutes the internal membrane: it lines the posterior half of the eye. It is formed by the ramification of the fibers of the optic nerve. [1]

I.3. Eye functions:

The eye is divided into three main parts:

- The cornea, the lens and the aqueous humor which behave like a lens since they allow light to pass through and focus on what we are looking at.
- The lens can bulge and cause the light rays entering through the aqueous humor and the cornea to converge, or it can flatten and in this case the light rays diverge. This is called accommodation. The state of the lens dependens on the distance at which the observed object is.
- The pupil which functions like a diagram since it makes it possible to regulate the quantity of incoming light and finally we have the retina which has the function of a screen where the image of observed object is formed.
- The retina sends electrochemical signals along the optic nerve to the brain. Once the signals have been interpreted, the interpretation allows us to see the image of the object. The process of bending light to produce an image in focus on the retina is called refraction.

However, there are also diseases that can make us blind, such as glaucoma that affects our optic nerve or cataracts that turn our lens yellow and cause opacification. [2]

I.4. Human vision:

Vision is not limited to visual acuity from afar, which is measured by reading letters or numbers from a distance translated by a number from 0 to 10. Its definition is much more complex because it includes other elements:

Near vision which is studied by reading a text in close vision.

The visual field which corresponds to the perceived environment, that is to say to the extent of space that the motionless eye can embrace.

- Color vision.

- The vision of contrasts which is defined as the difference in visibility between the background and the object.
- The vision of the relief, that is to say the vision in 3D.

The sensation of glare, linked to rapid changes in brightness, for example car headlights; this sensitivity is often particularly important in a visually impaired person.

In addition, visual performance of artificial depends very strongly on the light environment:

- Time of day, presence of artificial light..., the variation in this light environment and the person's degree of "tiredness". [1]

I.5. Visual blindness:

I.5.1. Visual impairment:

Visual impairment, also known as vision impairment, is a medical definition primarily measured based on an individual's better eye visual acuity; in the absence of treatment such as correctable eyewear, assistive devices, and medical treatment– visual impairment may cause the individual difficulties with normal daily tasks including reading and walking. Low vision is a functional definition of visual impairment that is chronic, uncorrectable with treatment or correctable lenses, and impacts daily living. As such low vision can be used as a disability metric and varies based on an individual's experience, environmental demands, accommodations, and access to services. The American Academy of Ophthalmology defines visual impairment as the best-corrected visual acuity of less than 20/40 in the better eye, and the World Health Organization defines it as a presenting acuity of less than 6/12 in the better eye. The term blindness is used for complete or nearly complete vision loss. [3]

I.5.2. Blindness:

Blindness is the absence of vision in one or both eyes. People suffering from blindness are therefore deprived of the sense of sight, partially (partial blindness) or totally (total blindness), in a disabling way. [4]

Legal blindness is defined in France by a corrected visual acuity of less than 1/20 for both eyes, and the following table shows us the types of visual impairment according to visual acuity:

Types of visual impairment	Visual acuity(after correction)	
	Maximum	Minimum
Visual impairment	3/10	1/10
	1/10	1/20
Blindness	1/20	1/50
	1/50	No perception of light
	No perception of light	No perception of light

Table I.1: visual impairment according to visual acuity.

I.5.3. Causes:

There are many visual diseases (listed in the following figure) which affect vision differently. Some diseases occur suddenly, others settle very gradually or evolve in stages and others appear from birth (genetically).

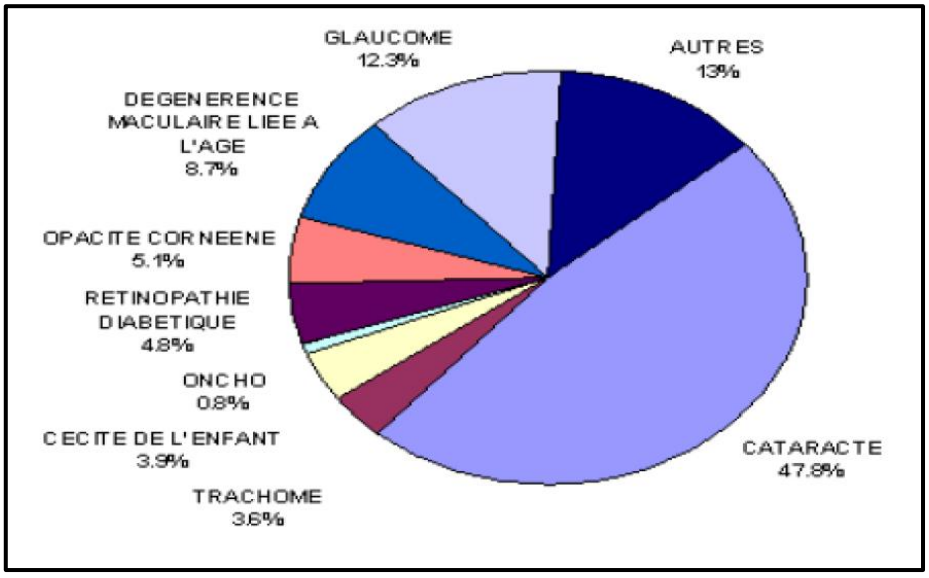


Figure I.2: origins of global blindness according to a study by the canading national institute for the blind (2005).

Here is a list of a group of diseases that can eventually lead to blindness:

1. Cataract

In this case, the lens becomes cloudy as a result of white water infection or so-called cataract, and other accompanying symptoms of the disease: blurred vision, double vision and sun intolerance.

As for the causes of this condition, they are as follows:

- aging
- The birth of a child with this condition.
- A bruise or injury to the eye.

The condition is usually treated by replacing the damaged lens, and success rates for this operation are high, and whether surgery is required or not, ongoing eye care under the supervision of a medical specialist is sufficient to preserve vision.

2. Diabetic retinopathy

One of the possible complications of diabetes is diabetic retinopathy, where vision loss can occur due to weak blood vessels in the retina, causing tearing and bleeding inside the eye.

When the eye tries to heal from the tear, the resulting scarring on the retina can lead to complete loss of vision. This condition is therefore a frequent cause of blindness in diabetics.

Usually, laser surgery is used to treat eyes with diabetic retinopathy with ongoing follow-up under the supervision of a doctor. The treatments available can cause peripheral vision loss, but they save the rest.

3. Glaucoma

Glaucoma, or so-called glaucoma, is one of the causes of sudden blindness.

Glaucoma gradually affects the eye, as follows:

- An overproduction of eye fluid or a defect in the eye fluid production and drainage system.
- Increased pressure on the eye.
- Damage to the optic nerve, which transmits visual signals to the brain.
- Blindness resulting from continuous pressure on the nerve.

A person may have glaucoma for a while without realizing it because the increased pressure in the eye does not cause any pain. Therefore, eye exams should always be performed periodically.

In very rare cases of the disease, glaucoma can cause severe pain in the head and sudden loss of vision.

But it should be noted here that this condition has no cure and the medical options available only prevent the condition from getting worse.

4. Age-related macular degeneration

Visual degeneration is one of the leading causes of blindness in people over the age of 55.

Inside the retina, the healthy eye contains an area populated by millions of light-sensitive cells that play a major role in producing the detailed images we see.

With age, these cells gradually begin to decline, causing blurry vision or the appearance of a black spot in the middle of vision.

There are two types of macular degeneration, dry and wet, with dry being the most common.

The medical specialist here can resort to treating the disease by injecting special injections into the eye, often monthly, or with other treatments, such as: laser.

5. Retinitis pigmentosa

Retinitis pigmentosa is a genetic disease in which the condition of the retina worsens day by day. It is usually diagnosed at an early age. It begins with night blindness, followed by progressive loss of vision, ending in tunnel vision.

There is no cure available to date for this specific disease, and retinitis pigmentosa often ends up causing complete blindness.

6. Stroke

The eye can lose sight in a certain direction as a result of a stroke or the presence of a brain tumor.

If the affected side of the field of vision is the right that means the damaged half of the brain is the left, and so on.

There is no treatment available for this condition, but the patient must adapt to it as much as they can, and a clot can be one of the causes of blindness in one eye. [5]

I.6. suffering of the blind and visually impaired:

The blind and visually impaired have difficulty getting around town for public transport and prior identification of the route. In addition, they have difficulties on a daily basis: reading texts, recognizing objects, etc. The most important thing is social interactions because they can't recognize people which make them feel inferior and marginalized.

I.6.1. definition of a blind person:

Legally blind means a person has a corrected vision of 20/200 in their best-seeing eye. If visual aids such as glasses can correct a person's vision to 20/20, they are not considered legally blind.

Totally blind refers to a complete loss of sight. [6]

I.6.2. definition of visual impairment:

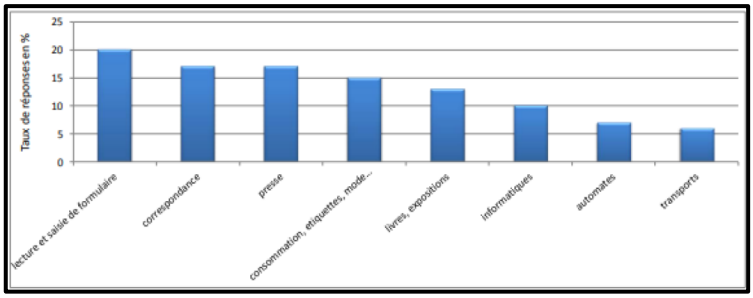
A visually impaired person is a person whose visual acuity is low (visually impaired), or even less than 1/20 for the best eye after correction (blind). Only 14% of visually impaired people are blind; the others are visually impaired. [7]

According to the WHO, visual impairments can be classified into 5 groups:

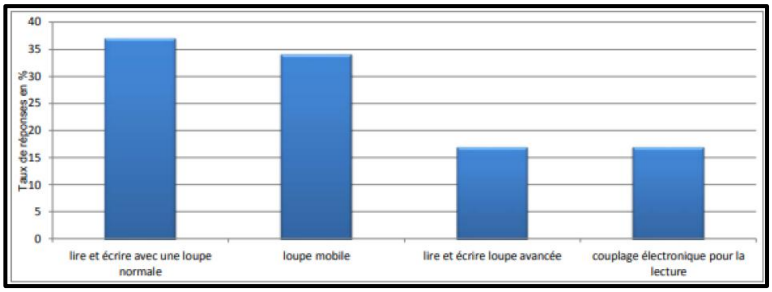
- Average visual impairment, which is characterized by a visual field greater than 20 degrees, and visual acuity between 1/10 and 3/10.
- Sever visual impairment, which is characterized by visual acuity between 1/20 and 1/10. The person is then able to count fingers at 3 meters.
- Profound visual impairment, which is characterized by visual acuity between 1/15 and 1/20. The person can count fingers at 1 meter.
- Almost total visual impairment, which is characterized by an acuity of less than 1/50, a reduced visual field, and the perception of light only.
- The last class corresponds to total blindness, which is characterized by the non-perception, including of light. [8]

I.6.3. Quantitative analysis of the needs of blind people:

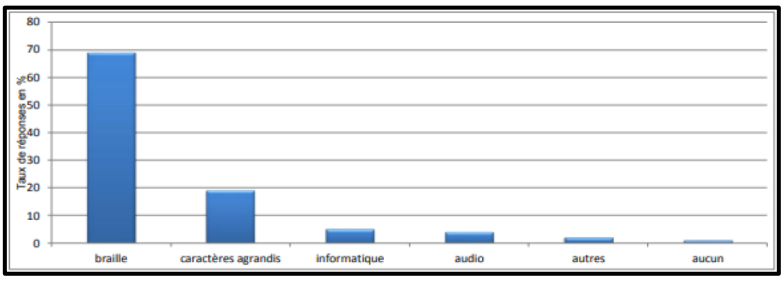
We will begin by analyzing the needs expressed by members of the handicap zero association during its 2005 survey. This study was chosen because it brings together the opinions of more than 700 French visually impaired people, and a certain number of needs are analyzed. It is important to note that the needs expressed in this study are very simple and yet very important for everyday life. Similarly, the technical aids offered to meet these needs are very simple; however, they are not necessarily accessible to everyone. [8]



(a) Reading Modes



(b) Technical solutions



(c) Mode of reading for the visually impaired and blind

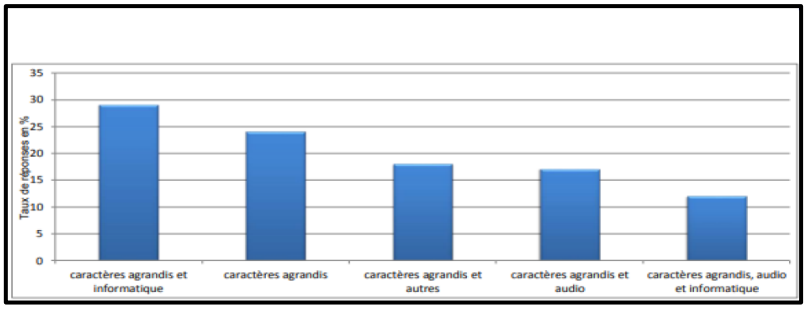


Figure I.3: Reading modes used by the visually impaired and technical solutions, data compiled by Laster from the handicapzero study.

I.7. technical aids for the visually impaired:

Technical aids are varied in nature. They bring together the arrangements for the development of the housing, prostheses, as well as the various materials used by people to compensate for their disabilities in daily life. Among these devices,

Some are specifically intended for the visual impairment compensation. These “Visual aids” are mainly used for movement (white canes, guide dogs) as well as tasks involving reading or writing (optical aids, Braille, etc). [9]

Visual technical aids are an essential tool for compensating for visual impairment. They are widely recommended, in addition to other techniques, in the various fields of visual rehabilitation for blind and visually impaired people.

I.7.1. Assistance for travel:

Improve the detection of obstacles and thus overcome the difficulties, frequently reported by the visually impaired, for travel outside the home. Among the blind, learning to use the long cane helps to make travel safer and thus reduces dependency.

I.7.1.1. Service Dogs:

Service dogs are dogs that are trained to help their owner with a specific disability. For example, dogs can be trained to pick things up, A golden retriever with a service dog vest visually guide those with visual impairments, remind you to take medication, or help those with poor balance.

Service dogs can go to public places with their owners, even places that dogs are not usually allowed to go like airplanes or restaurants. [10]

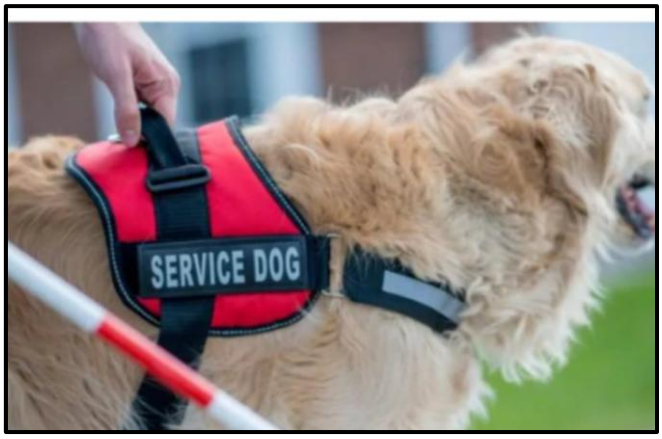


***Figure I.4**:* Service Dog

I.7.1.2. The smart cane:

We WALK attaches to the traditional white cane, transforming it into an innovative smart cane. This technology increases visually impaired people's independence and promotes full-participation in society via three of its features.

- Detects Obstacles: We WALK detects obstacles above chest level with an ultrasonic sensor and vibrates when these objects are near.
- Paired with Phone: When paired with the We WALK mobile application via Bluetooth, the user can use apps with We Walk's touchpad, without holding his or her phone. For example, the user can get navigation on the We WALK device.
- Evolves with Integrations: We WALK is integrated with "Google Maps" and "Amazon Alexa." In the future, We WALK will be integrated with Smart City Applications. These new integration features are installed through periodic software updates. [11]

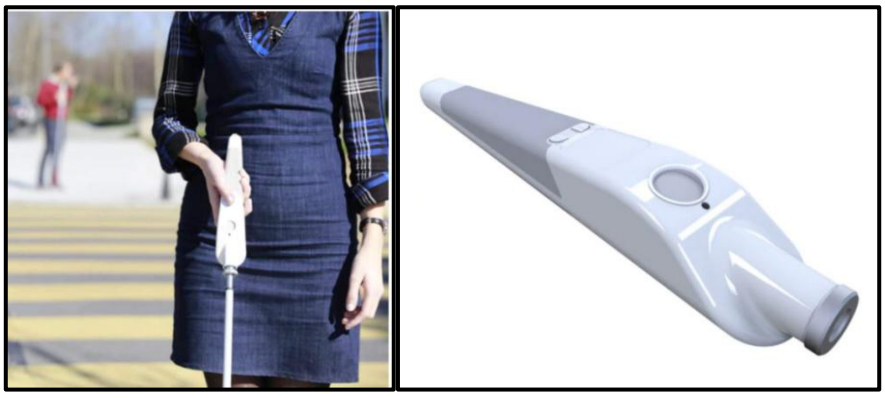


Figure I.5: smart cane We WALK.

I.7.2. Optical aids:

(Magnifying glasses, microscopic systems, telescopic systems) or electronic aids (video magnifiers) which enlarge the retinal image and improve the perception of details, serve to increase visual capacity. They can be adapted depending on the case for far or near vision and their use requires more or less long learning. Each type of has a different magnification in order to best adapt to each type of low vision or each use. [9]

I.7.2.1. Electronic magnifiers:

Electronic magnifiers offer better quality than traditional magnifiers: no image distortion, better quality, magnification that can be higher, more brightness and even available contrast modes. Its price is more important, but it has many advantages, such as mobility, weight, etc.

Figure I.6: portable electronic magnifier.

I.7.3. Communication aids:

Using Braille, voice syntheses, possibly by means of computer interfaces, are intended for the most deficient people. They also require, and even more so then optical aids, learning. The development of new information and communication technologies (NTIC), in particular the internet, has considerably improved access to information for the visually impaired. [9]

I.7.3.1. Braille:

Literacy—the ability to read and write—is vital to a successful education, career, and quality of life in today's world.

Whether in the form of curling up with a good book, jotting down a phone number, making a shopping list, or using a computer to write a report, being literate means participating effectively at home and in society.

Although learning to read and write in traditional ways may not be possible when you cannot see print on a page, there are many other paths to becoming literate. Learning to read and write in Braille can make a dramatic difference in the life of a visually impaired child or adult. Braille is an irreplaceable and modern method for literacy.

When you first touch something written in Braille, it will probably feel like a jumble of dots. However, like any other code, Braille is based on a logical system. Once you understand it, you'll be able to read and write Braille easily. That's because Braille is not a language, it's just another way to read and write English—or any other language, such as Japanese.

There are many tools available for enhancing vision for reading print, and for accessing Braille and electronic materials. Learning to use devices like magnifiers and computers equipped with software that simulates a human voice, or portable electronic Braille devices can also open up the world of literacy for someone with a visual impairment. [12]

Braille is systems of raised dots that can be read with the fingers by people who are blind or who have low vision. Teachers, parents, and others who are not visually impaired ordinarily read Braille with their eyes. Braille is not a language. Rather, it is a code by which many languages—such as English, Spanish, Arabic, Chinese, and dozens of others—may be written and read. Braille is used by thousands of people all over world in their native languages, and provides a means of literacy for all. [12]

Figure I.7: Braille Font. Braille text generator.

I.8. Illiteracy:

Illiteracy is a state whereby one is unable to read and write. In its simplest form, it can be defined as lack of any or sufficient education.

Sometimes people who have had very basic education also experience challenges in reading and writing.

Illiteracy can also mean ignorance or the lack of knowledge in a specific subject. For example, a person may have gone to school but does not know how to operate a computer. Such an individual has no literacy in computer and is known as computer illiterate. Nearly every job advertised requires one to have computer literacy due to the digitization of most processes at the workplace.

A mistake in reading or writing that is seen to be characteristic of an illiterate person is also referred to as illiteracy. For this definition, a speech or letter that has several errors can be said to be full of illiteracies.

Functional illiteracy, on the other hand, is used to describe a situation where a person has writing and reading skills considered inadequate to perform employment duties that demand reading and writing skills that go beyond the basic level. [13]

I.8.1. Causes of illiteracy:

There are so many reasons why an individual can be illiterate. These are some of the causes of the inability to read or write:

1. Illiteracy among parents: Many illiterate parents do not put much emphasis on the importance of education. Several of those born to parents who can neither read nor write end up being illiterate. This is especially true in remote areas where many people in the older generation have not gone through formal education. The reverse is true for those who have

been brought up by parents with an elaborate educational background. They realize the necessity of taking their children to school and therefore ensure that they receive a good education.

2. Lack of family support: This can be the cause of illiteracy more so where a child has difficulty reading or writing because of dyslexia. In a situation where the family does not understand the child's condition, it may simply be assumed that he or she is not a bright person and maybe school is not meant for everyone. Supportive family members help a child overcome reading disability and go through formal education with minimal challenges.

3. Unemployment of the educated: Some people believe that the only reason someone should go to school is so that he or she can get a good job and make a good life. Without the promise of employment, education is not a necessity to them. In a country where many of the educated are unemployed, there may not be enough motivation for the illiterate to go to school. After all, they reckon, why would you spend so much money paying for your education when there is no promise of a return on investment? In countries where those who have gone to school have good jobs and reasonable incomes, there may be sufficient motivating factors for people to get rid of illiteracy.

4. Lack of awareness: In places where several members of the local population do not understand why it is important for them to go to school, the level of illiteracy may be high. Disinterest in the benefits of formal learning can also be caused by lack of awareness on the importance of going to school. The number of illiterate people in urban areas tends to be lower than that of those in rural areas. People in towns are more aware of the need to eliminate illiteracy, the challenges that arise from lack of education and the social benefits of being literate compared to those who live in the remote place. [13]

I.9. Conclusion:

In this chapter, we have clarified the importance of vision, as well as the anatomy and function of the eye. We introduced some concepts of human vision. We also mentioned the various causes that lead to visual impairment. At the end of the chapter, we conclude that the eye is an organ of human vision, as it allows him to take pictures and then analyze theme to interact with the environment. This chapter also includes different techniques that are actually designed to help people with visual impairments.

In the second chapter, we will begin to identify shapes and apply them to images.

Chapter II:

Pattern recognition and extracting objects from images

II.1. Introduction

Recognizing objects from a picture or a video is one of the studies that are interested at artificial intelligence, as it helps in facilitating work especially in the field of medicine.
In this chapter, we will talk about recognizing things from a picture or video, algorithms and their application in the real life.

II.2. Pattern recognition

II.2.1. Definition

Pattern recognition refers to a set of techniques and methods aimed at identifying patterns from raw data in order to make a decision depending on the category attributed to this pattern. It is considered to be a branch of artificial intelligence that makes extensive use of machine learning techniques and statistics.

The shapes or patterns to be recognized can be of a very varied nature. It can be visual content (bar code, face, fingerprint, etc.) or sound (speech recognition), medical images (X-ray, EEG, MRI, etc.) or multispectral (satellite images) and many more others [3].

Watanabe [1] defined a form as: “the opposite of chaos; it is a vaguely defined entity, to which one can associate a name”. In computing terms, a shape is a set of values, called attributes, to which is associated a name (or label), which is their class. Several forms can have the same class, we then say that they are the examples or realizations of the class.

II.2.2. Where we use pattern recognition?

Pattern recognition is used to give human recognition intelligence to machines that are required in image processing. Pattern recognition is used to extract meaningful features from given image/video samples and is used in computer vision for various applications like biological and biomedical imaging. [5]

II.3. Methods

- Pattern recognition can be performed using various machine learning algorithms such as:

- A neural network
- Statistical analysis
- The use of hidden Markov models
- A search for isomorphism of graphs or sub-graphs

- The shapes sought can be geometric shapes, describable by a mathematical formula, such as:
    - Circle or ellipse
    - Bezier curves, splines
    - Right
- They can also be more complex in nature:
    - Letter
    - Cipher
    - Fingerprint

Recognition algorithms can work on black and white images, with white outlines of objects in the image. These images are the result of edge detection algorithms. They can also work on predefined areas of the image resulting from the segmentation of the image [3].

II.3.1. Pattern recognition methods:

- Graph matching
- Bayesian method
- Parametric Estimation
- Linear classifier
- Neural network
- Local feature focus
- SVM: Support Vector Machine
- Constraint polytopes
- Hypercube method

A well-known algorithm for pattern detection, the Hough transform, is a parametric estimation method. [3]

II.4. Block diagram of a pattern recognition system:

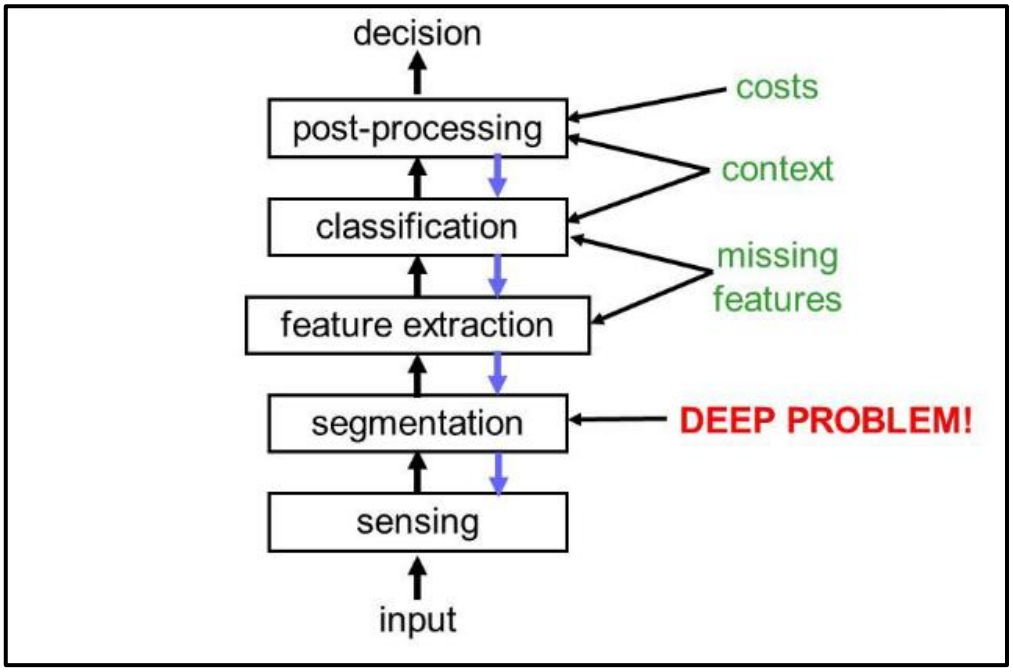


Figure II.1: block diagram of a pattern recognition system. [7]

II.4.1. Block diagram explanation:

1. The sensor: converts images or sounds or other physical input into signal data. [7]

2. Segmentation: is the part which enables segregating sensed object from the background noise. [7]

3. The feature extractor: measure object properties and select those features that are important for classification. [7]

4. The classifier: use these features to assign the sensed object to a category. [7]

5. The post-processor: can take account of other considerations such as the cost of the error to decide appropriate action. [7]

II.5. Beginning on research in pattern recognition:

When the causes of low vision or blindness are not treatable and the deficit will remain permanent, as in the case of macular degeneration, glaucoma or numerous corneal opacities, different solutions have been proposed to compensate for the visual loss, and restore, if not real visual sense, at least some of the lost functions. Two categories of systems stand out.

On the one hand, holistic approaches, aiming to restore visual information in its entirety. this is the common approach of sensory substitution systems and neuroprostheses that we will develop here. On the other hand specific aids, trying to meet the needs identified in specific tasks, which will be discussed in the next section. [2]

II.6. Letter recognition:

II.6.1. Braille "Universal system for blind people"

Is a tactile writing system used by people who are visually impaired, including people who are blind, deafblind or who have low vision. It can be read either on embossed paper or by using refreshable braille displays that connect to computers and smartphone devices. Braille can be written using a slate and stylus, a braille writer, an electronic braille notetaker or with the use of a computer connected to a braille embosser. [8]

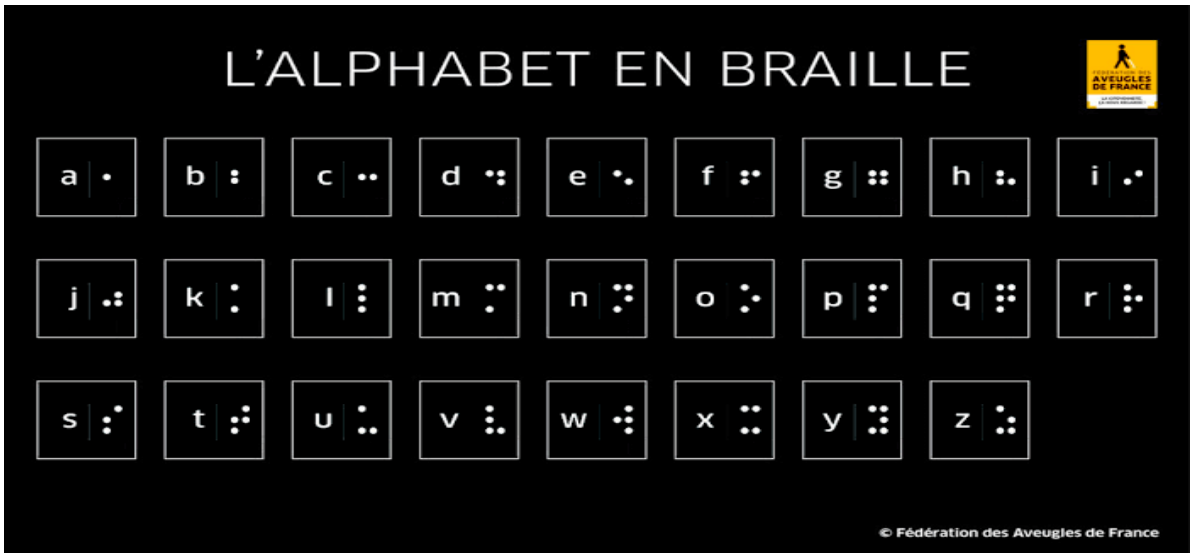


Figure II.2: Braille alphabet

II.6.2. Handheld optical magnifier:

The handheld magnifier is very practical because it is equipped with a handle that allows it to remain mobile. With a hand magnifier, you can magnify anything you want (cooking plate, button, medicine box, etc.) simply by holding the magnifying glass by its handle.

The hand magnifier also makes it possible to adapt the distance between the document to be read and the lens. The majority of our hand magnifiers are equipped with LEDs. The LEDs integrated in the illuminating magnifying glass with three colors make it possible to greatly

increase the luminosity and thus improve the visual rendering [4] .But intended just for the visually impaired not for people who are visually impaired.

Figure II.3: handheld magnifier Eschenbach.

II.6.3. mobile electronic magnifier:

Electronic magnifying glasses allow a much greater magnification than traditional magnifying glasses, which explains why they render undeniable services to visually impaired people and those suffering from macular degeneration, cataracts, diabetic retinopathy, retinitis pigmentosa or glaucoma. Their dial and their luminosity offer unequaled viewing comfort. T.hey allow you to choose the level of magnification and change the contrast according to the needs of the visually impaired person [8].

Figure II.4: mobile electronic magnifier.

II.6.4. TVs enlargers and video enlargers

Video magnifiers are enlargement devices equipped with a camera, which allow you to view any document on a screen (provided or not, depending on the model). Multiple functionalities may be available, some even offer OCR and voice synthesis functions which allow automatic reading of the document presented. This is the case, for example, of the MLS TTS HD video magnifier, particularly suitable for schooling.

Figure II.5: TVs enlargers and video enlargers.

II.6.5. Smart glasses for the visually impaired

Iris Vision electronic glasses for the blind and visually impaired are a highly innovative assistive technology solution, which is registered with the FDA as a Class-1 medical device and is redefining the concept of wearable low vision aids. [9]

A combination of a Samsung's VR headset and a smartphone, IrisVision gives birth to an innovative solution aimed at helping people with eye problems like macular. [9] degeneration, cataracts, glaucoma, diabetic retinopathy (DR), retinitis pigmentosa (RP) and so forth. [9]

Figure II.6: Smart glasses IrisVision. [9]

II.7. Objects recognition and localization:

II.7.1. Definition:

Object recognition is a general term to describe a collection of related computer vision tasks that involve identifying objects in digital photographs.

Image classification involves predicting the class of one object in an image. **Object localization** refers to identifying the location of one or more objects in an image and drawing abounding box around their extent. *Object detection* combines these two tasks and localizes and classifies one or more objects in an image.

When a user or practitioner refers to "**object recognition**", they often mean "**object detection**". [10]

II.7.2. Computer vision tasks:

- **Image Classification:** Predict the type or class of an object in an image.
    - **Input:** An image with a single object, such as a photograph.
    - **Output:** A class label (e.g. one or more integers that are mapped to class labels).
- **Object Localization:** Locate the presence of objects in an image and indicate their location with a bounding box.
    - **Input:** An image with one or more objects, such as a photograph.
    - **Output:** One or more bounding boxes (e.g. defined by a point, width, and height).
- **Object Detection:** Locate the presence of objects with a bounding box and types or classes of the located objects in an image.

- **Input:** An image with one or more objects, such as a photograph.
- **Output:** One or more bounding boxes (e.g. defined by a point, width, and height), and a class label for each bounding box. [10]

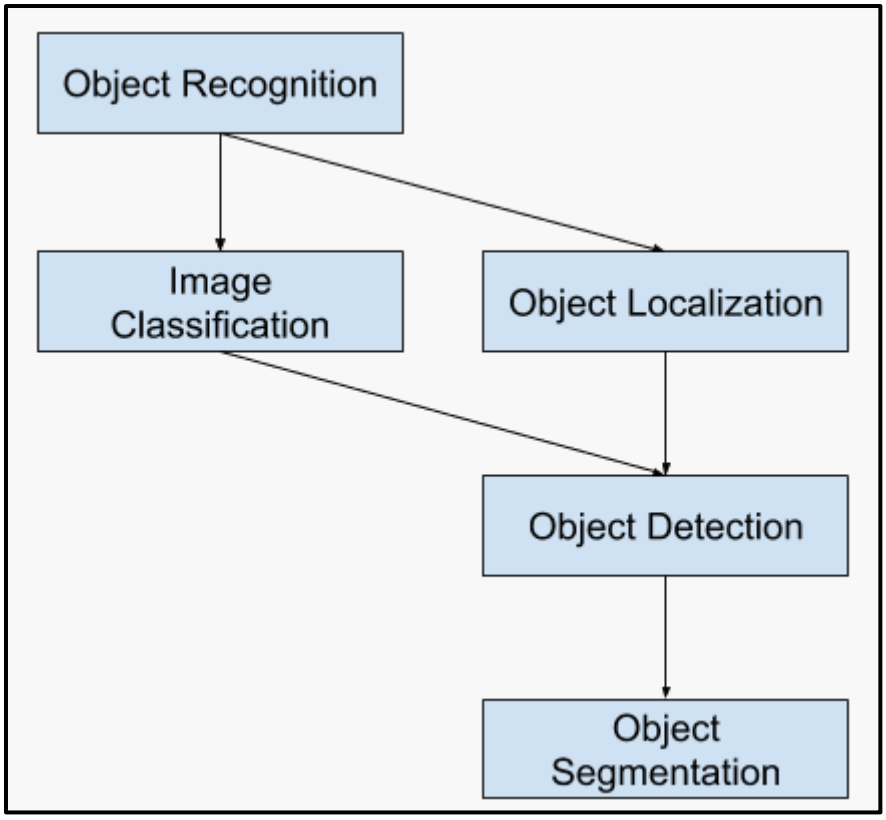


Figure II.7: overview of object recognition Computer Vision Tasks. [10]

II.7.2. The list of the three corresponding task types:

- **Image classification:** Algorithms produce a list of object categories present in the image.
- **Single-object localization:** Algorithms produce a list of object categories present in the image, along with an axis-aligned bounding box indicating the position and scale of one instance of each object category.
- **Object detection:** Algorithms produce a list of object categories present in the image along with an axis-aligned bounding box indicating the position and scale of every instance of each object category. [10]

Below is an example comparing single object localization and object detection, taken from the ILSVRC paper. the difference in ground truth expectations in each case. [10]

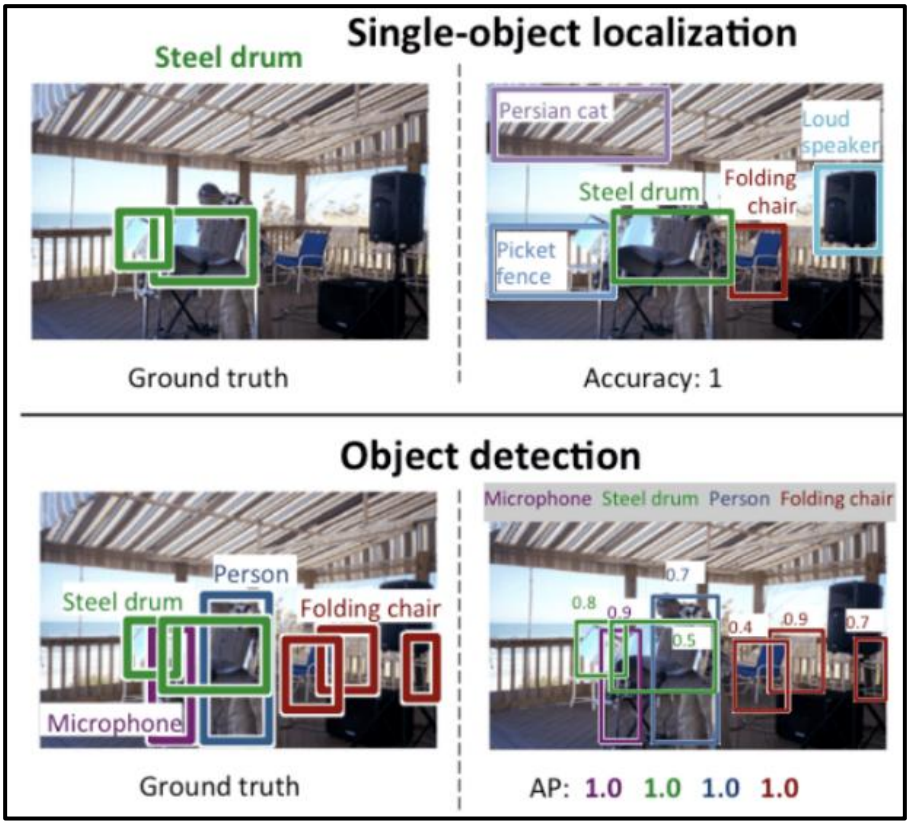


Figure II.8: comparison between object localization and object detection [10]

II.7.4. Smart cane:

A white cane that uses smart technology aims to help visually-impaired people navigate their surroundings. Called We WALK, the device is equipped with built-in speakers, Smartphone integration, and sensors that send vibrations to warn users of obstacles up ahead.

The We WALK cane consists of an electronic handle with a regular 'analog' white cane that is inserted into the bottom. it uses an ultrasonic sensor to detect any obstacles above chest level and warns the user via a vibrating handle. [11]

Figure II.9: Smart cane. [11]

II.8. Face recognition:

II.8.1. Definition:

A facial recognition system is a technology capable of matching a human face from a digital image or a video frame against a database of faces, typically employed to authenticate users through ID verification services, works by pinpointing and measuring facial features from a given image.

Development began on similar systems in the 1960s, beginning as a form of computer application. Since their inception, facial recognition systems have seen wider uses in recent times on Smartphone and in other forms of technology, such as robotics. Because computerized facial recognition involves the measurement of a human's physiological characteristics, facial recognition systems are categorized as biometrics. Although the accuracy of facial recognition systems as a biometric technology is lower than iris recognition and fingerprint recognition, it is widely adopted due to its contactless process. [12] Facial recognition systems have been deployed in advanced human–computer interaction, video surveillance and automatic indexing of images. [13]

II.8.2. OR cam:

Is an intuitive wearable device with a smart camera to place on a person's eyeglass frame. The device uses the power of artificial vision to help people living with vision loss. These are interactive glasses that allow blind people to "see" their environment in everyday life. [17]

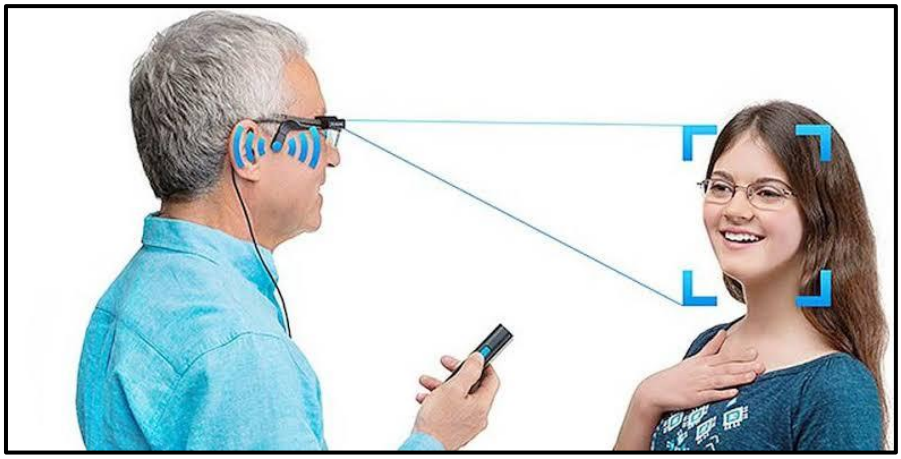


Figure II.10: OR cam glasses.

II.9. Pattern recognition from an image:

II.9.1. Definition of an image

An image is an artifact that depicts visual perception, such as a photograph or other two-dimensional picture, that resembles a subject usually a physical object and thus provides a depiction of it. In the context of signal processing, an image is a distributed amplitude of color(s). A pictorial script is a writing system that employs images as symbols for various semantic entities, rather than the abstract signs used by alphabets. Images may be two or three-dimensional, such as a photograph or screen display, or three-dimensional, such as a statue or hologram. They may be captured by optical devices such as cameras, mirrors, lenses, telescopes, microscopes, etc. and natural objects and phenomena, such as the human eye or water. [14]

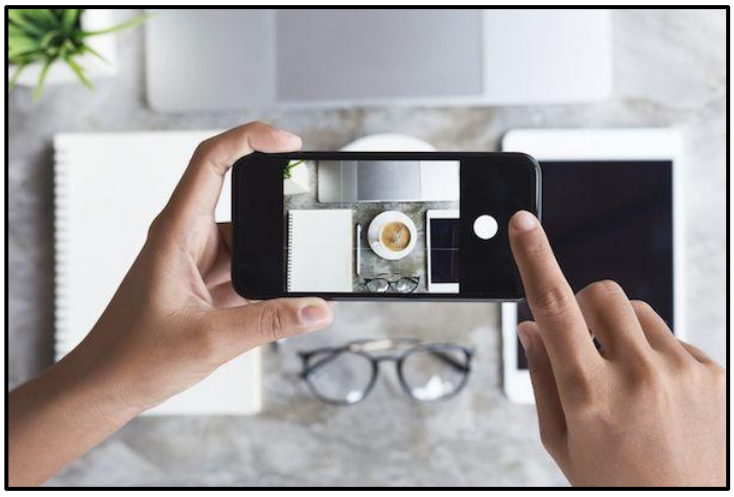


Figure II.11: an image.

II.9.2. Digital image

A **digital image** is an image composed of picture elements, also known as pixels, each with finite, discrete quantities of numeric representation for its intensity or gray level that is an output from its two-dimensional functions fed as input by its spatial coordinates denoted with x, y on the x-axis and y-axis, respectively.

The term **digital image** refers to any image (drawing, icon, photograph, etc.) acquired, created, processed and stored in binary form1:

- acquired by analog-to-digital converters located in devices such as scanners, digital cameras or camcorders, video capture cards (which directly digitize a source such as television)
- created directly by computer programs, using a mouse, graphics tablets or by 3D modeling (so-called, by misuse of language, "synthesis images");
- processed using graphic tools, in order to transform it, modify its size, colors, add or remove elements, apply various filters, etc. [15]

II.9.2.1. Digital image types:

There are two types of images with different composition and behavior: raster images and vector images.

1. Raster images:

In computer graphics and digital photography, a **raster image** represents a two-dimensional image as a rectangular matrix or grid of square pixels, viewable via a computer display, paper, or other display medium. A raster is technically characterized by the width and height of the image in pixels and by the number of bits per pixel. Raster images are stored in image files with varying dissemination, production, generation, and acquisition formats. [15]

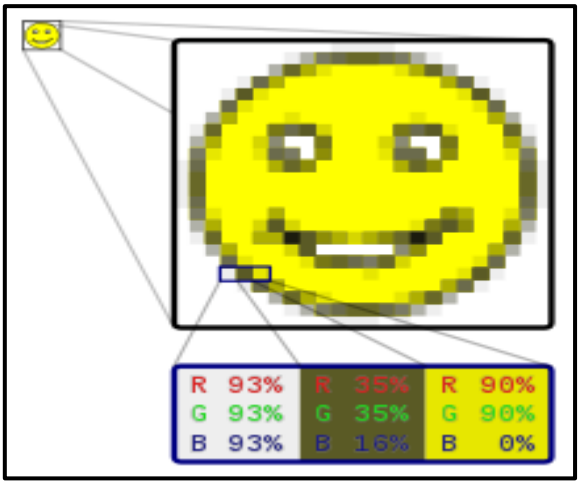


Figure II.12: raster image [15]

2.Vector images:

Vector images, as a form of computer graphics, is the set of mechanisms for creating visual images directly from geometric shapes defined on a Cartesian plane, such as points, lines, curves, and polygons. These mechanisms may include vector display and printing hardware, vector data models and file formats, and software based on these data models (especially graphic design software, computer-aided design, and geographic information systems). Vector graphics is an alternative to raster graphics, each having advantages and disadvantages in general and in specific situations. [15]

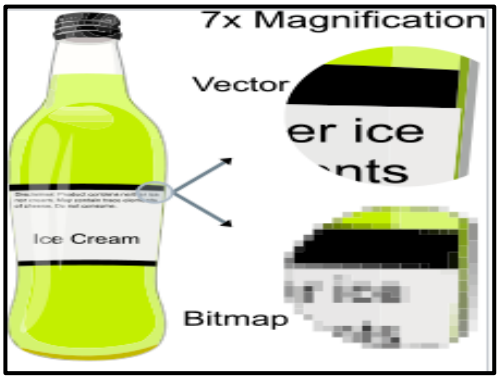


Figure II.13: vector image [15]

II.9.2.2. Digital image formalism:

From a mathematical point of view, an optical image is generally represented by a two-dimensional function representing particular characteristics of the light signal of the image at each point of its space (intensity, color, etc.). The transition to a digital representation is done by realizing a discretization of the spatial coordinates of this signal in the two dimensions of

the image (giving the definition of the image), and a discretization of the signal by sampling (quantification) digitally coded with a certain precision (numbers coded on a certain number of bits). The image is therefore made up of a regular set of elements called “pixels” and is generally called a “bitmap” image. [16]

II.9.2.3. Pixel:

A pixel is one of the small dots or squares that make up an image on a computer screen. The more pixels there are, the more the image looks real or accurate.

Any digital image is made up of pixels, and when someone talks about the resolution of a computer monitor or TV screen, they're referring to the number of pixels. Older televisions have around 300,000 pixels, but new high-definition TVs can have more than two million pixels, which produces a very sharp, clear image. The word pixel came from pictures, or pics, and element, and was coined in 1969. [19]

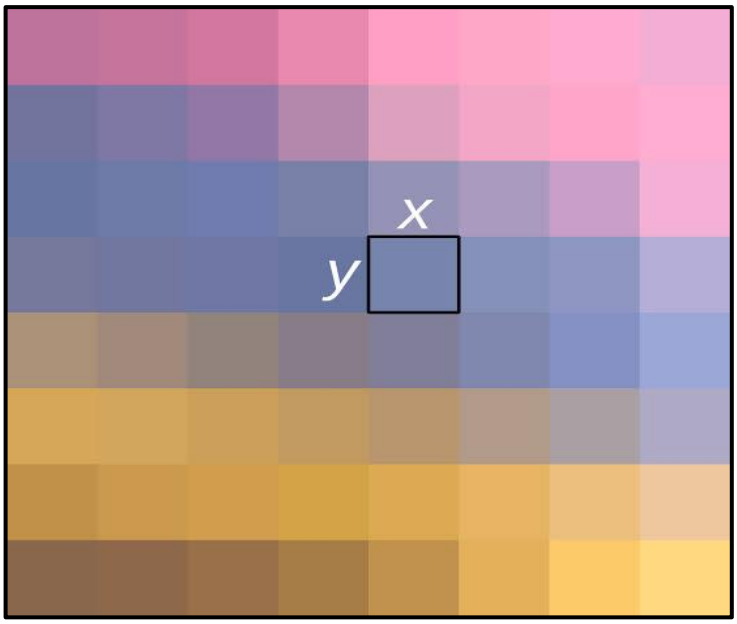


Figure II.14: presentation of a pixel.

II.9.2.4. Image segmentation

Let’s understand image segmentation using a simple example. Consider the below image :

There's only one object here – a dog. We can build a straightforward cat-dog classifier model and predict that there's a dog in the given image. But what if we have both a cat and a dog in a single image?

We can train a multi-label classifier, in that instance. Now, there's another caveat – we won't know the location of either animal/object in the image.

That's where image localization comes into the picture (no pun intended!). It helps us to identify the location of a single object in the given image. In case we have multiple objects present, we then rely on the concept of object detection (OD). We can predict the location along with the class for each object using OD. [20]

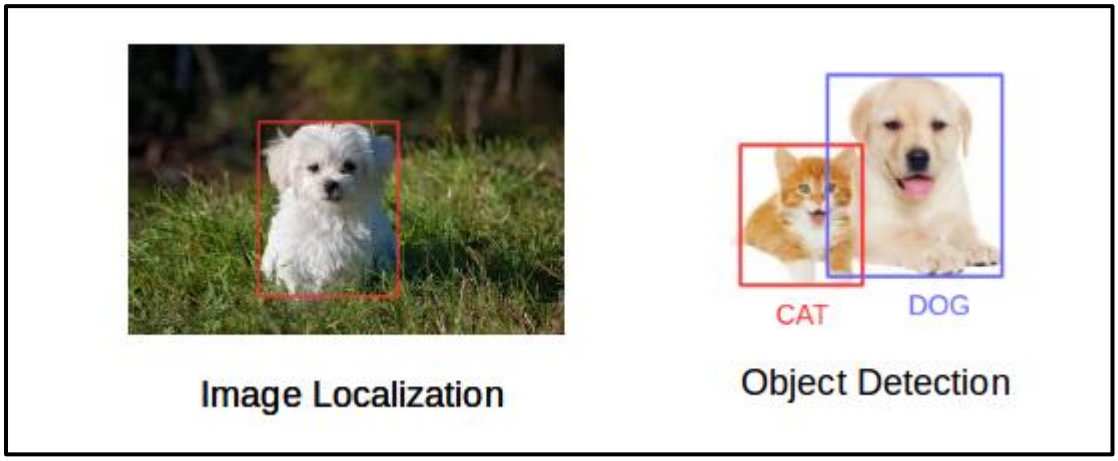


Figure II.15: detect object in image.

II.9.3. Image segmentation:

II.9.3.1. How does image segmentation work?

We can divide or partition the image into various parts called segments. It's not a great idea to process the entire image at the same time as there will be regions in the image which do not contain any information. By dividing the image into segments, we can make use of the important segments for processing the image. That, in a nutshell, is how image segmentation works. [20]

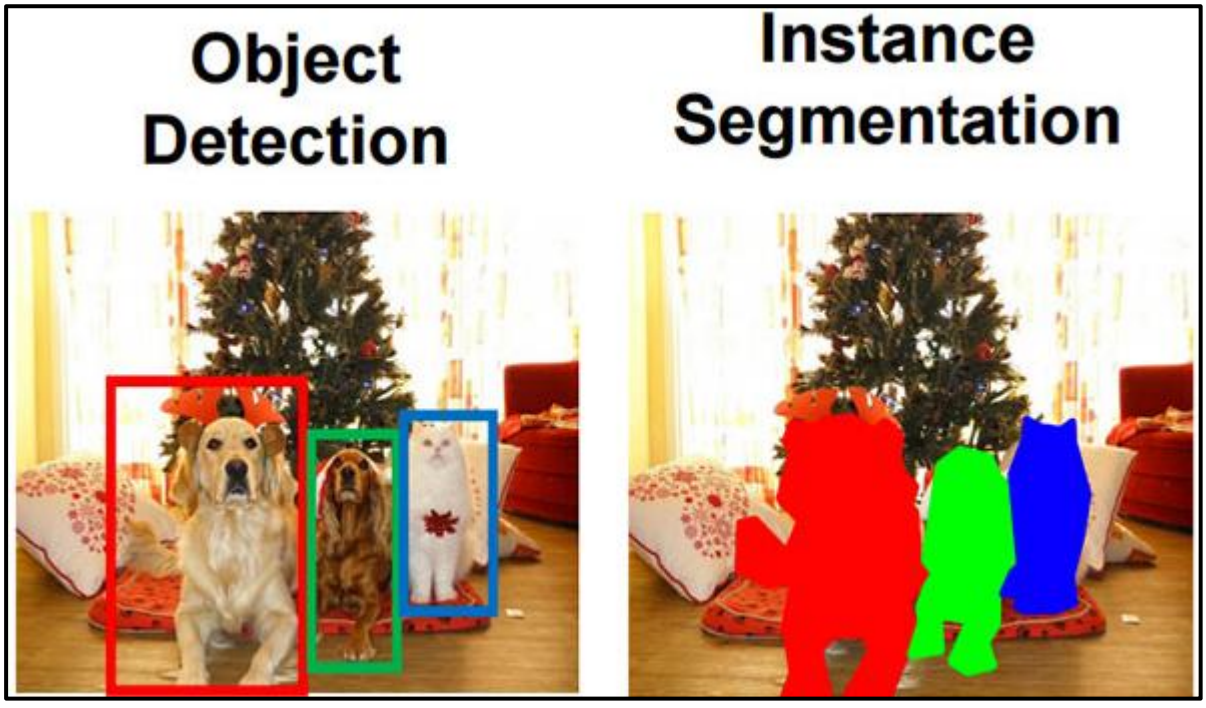


Figure II.16: image segmentation 1. [20]

II.9.3.2. The different types of segmentation

a. Segmentation by regions.

b. Segmentation by thresholding.

c. Segmentation by contours.

d. The Hough Transform.

We can broadly divide image segmentation techniques into two types. Consider the below images:

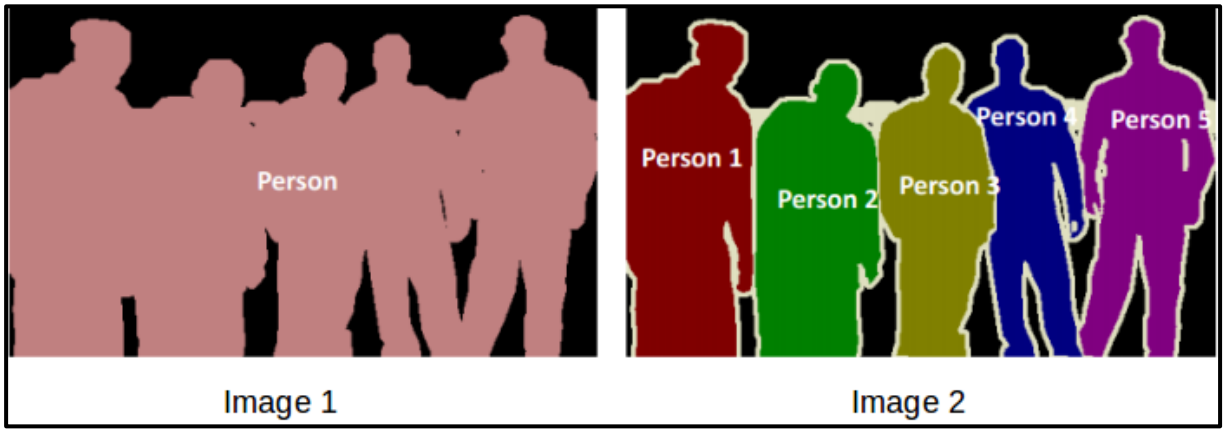


Figure II.17: image segmentation 2.

Both the images are using image segmentation to identify and locate the people present. [20]

- In image 1, an example of semantic segmentation, every pixel belongs to a particular class (either background or person). Also, all the pixels belonging to a particular class are represented by the same color (background as black and person as pink).
- Image 2, an example of instance segmentation, has also assigned a particular class to each pixel of the image. However, different objects of the same class have different colors (Person 1 as red, Person 2 as green, background as black, etc.).

a. Segmentation by regions:

The segmentation will consist in grouping the pixels of the image into regions (connected components). These regions satisfying a homogeneity criterion (for example on the gray levels or on the texture...). We seek by this processing to obtain a description of the image in regions, it can be located in the more general framework of data segmentation

Each of these regions must correspond to an object in the image because, in this image analysis method, the ultimate objective is to be able to break down an image into a group

of distinct objects. In general, these objects have their own properties with respect to the image itself. Thus, it is possible to distinguish such objects by different measures such as:

- Their related aspect
- Their consistent color
- Their outlines
- Their texture
- A priori information

The advantage of detecting regions is to be able to manipulate them afterwards to extract characteristics of shape, position, size... [18]

b. Segmentation by thresholding :

The purpose of thresholding is to segment an image into several classes using only the histogram. It is therefore assumed that the information associated with the image alone allows segmentation, that a class is characterized by its distribution of gray levels. Each peak in the histogram is associated with a class. [18]

c. Segmentation by contours:

Many practical problems of image analysis require a preliminary analysis where it is necessary to cut the image into homogeneous regions separated by contours. In general, homogeneous regions are regions where the light intensity varies slowly as a function of spatial coordinates. The contours separating these regions are narrow portions of the image (width of the order of one pixel) where the intensity variations are significant. There are many methods to detect

the contours, hence another image segmentation approach is the search for the contours of the regions [18]

d. The Hough transform:

The Hough transform is a pattern recognition technique invented in 1962 by Paul Hough. The simplest application is to identify the presence of lines in an image. It can be very

easily extended to circle recognition and other simple mathematical models. There is also a generalized Hough transform. [18]

II.10. Text extract:

II.10.1. OCR "Optical character recognition":

OCR (optical character recognition) is the use of technology to distinguish printed or handwritten text characters inside digital images of physical documents, such as a scanned paper document. The basic process of OCR involves examining the text of a document and translating the characters into code that can be used for data processing. OCR is sometimes also referred to as text recognition. [21]

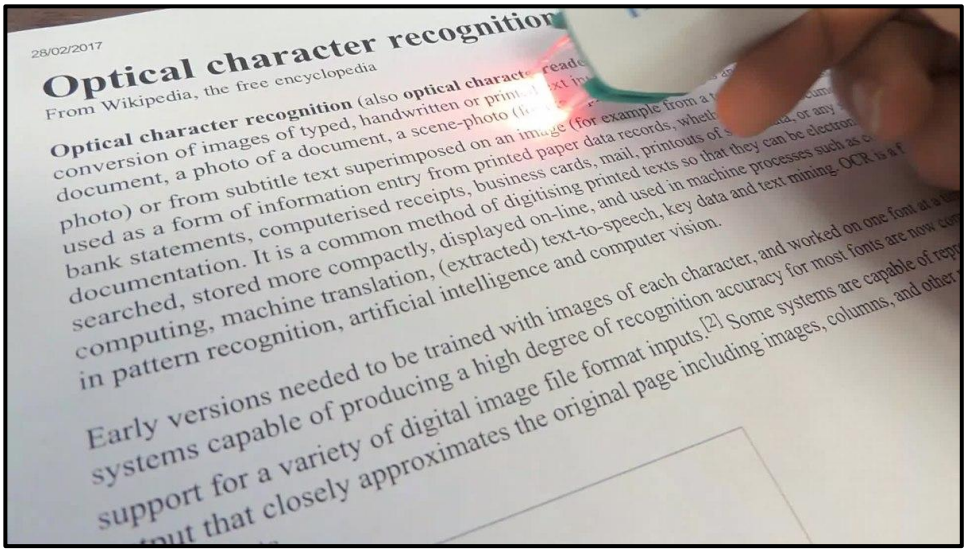


Figure II.18: OCR "Optical character recognition.

II.10.2. How OCR work?

The first step of OCR is using a scanner to process the physical form of a document. Once all pages are copied, OCR software converts the document into a two-color, or black and white, version. The scanned-in image or bitmap is analyzed for light and dark areas, where the dark areas are identified as characters that need to be recognized and light areas are identified as background. [21]

II.10.3. OCR, extract text from an image

You have digitized a newspaper or recovered the image of an article and you wish to be able to use the text contained in these documents [22]. To simplify your task, you can turn to

OCR, a computer process for optical character recognition [30]. Recover text in the image of a printed text, but also of a scanned sheet and even of a PDF document [22]. You can extract and recover your text through a special program that allows you to convert the text content of the image captured by the computer camera into audio text at any time.

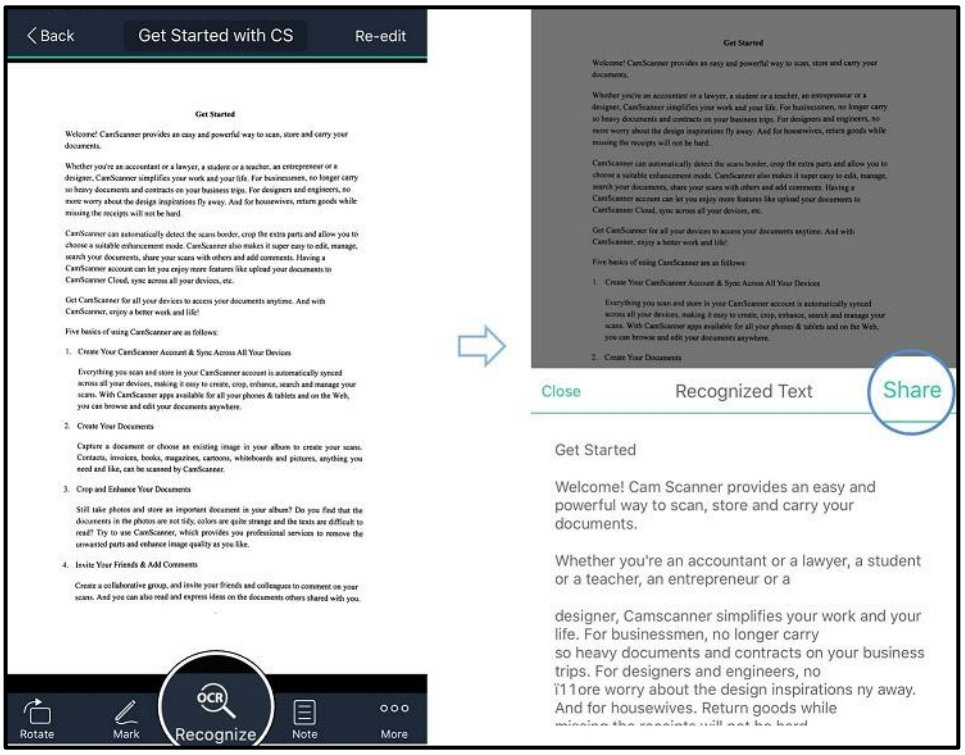


Figure II.19: Extract text from an image.

II.11.Conclusion:

In this chapter, we presented state of the art and some systems for the blind people and visually impaired. In the next chapter, we will explain the work of the glasses, as well as the methods used to design and implement this project.

Chapter III:

Conception and implementation

III.1. Introduction:

After looking at the discovery and identification of shapes from a picture in the previous chapter, we will talk in this chapter about the problems that blind and illiterate people face in reading and our solution provided for this category of people, and we will also explain how the smart glasses work for the previously mentioned category, then talking about the project's goal.

Then we will refer to the materials used to manufacture our smart glasses and the methods used to complete this project.

III.2. Conception:

In this part, we will talk about the problem of reading for blind, illiterate people and our solution propose to help them. After that, we will speak about the concept of our smart glasses and how it works.

III.2.1. Project goal:

The goal of this project is to provide a small electronic device works with an android application to help the visually impaired, the blind as well as the illiterate to overcome the problems they face in reading.

III.2.3. Problem and solution:

We will explain in these lines the main problem for which we chose this topic. Despite the development of assistive systems for the blind, there are still problems facing them, just as the illiterate face some problems such as reading.

We aim in this project to develop smart glasses that help visually impaired, blind and illiterate people to meet their needs as much as possible:

- Take a picture.
- Send it via Bluetooth
- Extract the text from this picture.
- Convert text to speech.

III.2.4. Working principal:

This part consists of studying the principle of the electronic circuit. The circuit consists of an OV7670 camera connected to an Arduino Uno card, the latter connected with a Bluetooth to send information to the android application.

To operate the circuit we point the glasses with a camera at the text to be read in a book, for example, or a newspaper...etc. This camera is connected to an Arduino Uno card, latter of which is connected to the HC-05 Bluetooth, So when eh camera take a picture the image will sent to the phone for process it in the Android application, which in turn recognizes text using OCR technology, and in the end an voice message that is heard by the blind person through headphones.

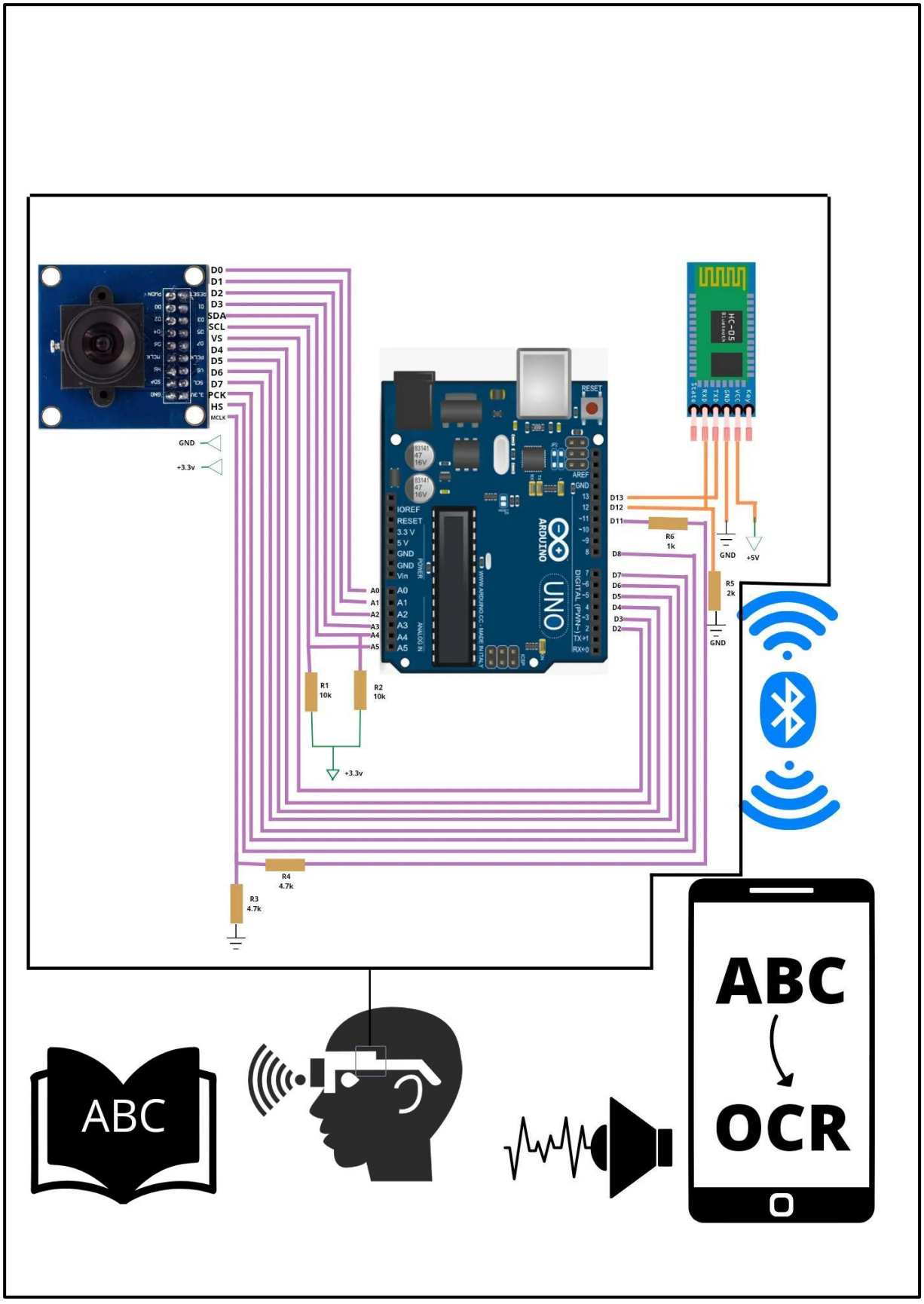


Figure III.1: Electronic diagram

III.2.5. Organigram:

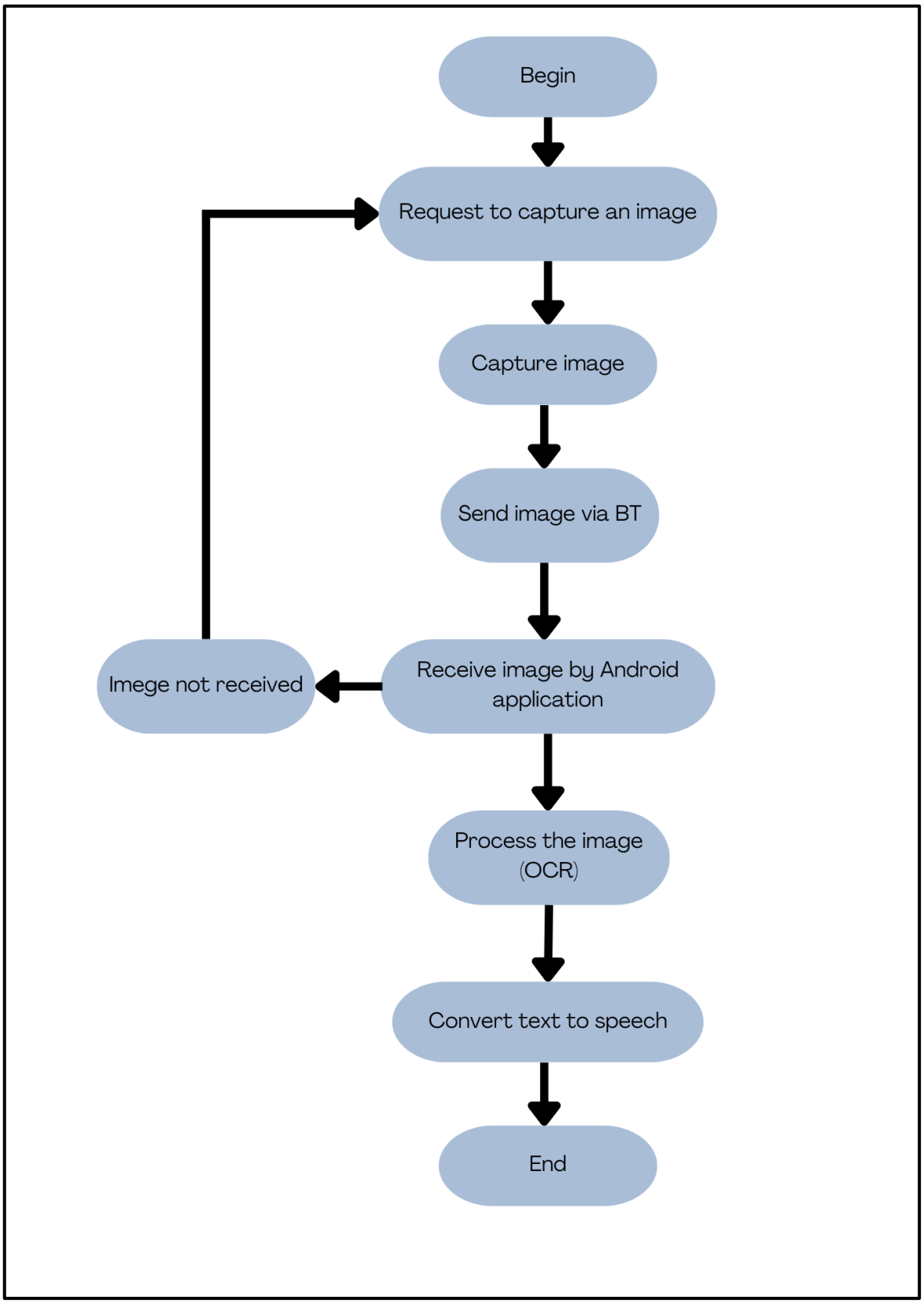


Figure III.2: Working diagram.

III.3. Implementation:

In this part, we will talk about our method of building the application, using Arduino and Android Studio, as well as how the application works.

III.3.1. Arduino:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Figure III.3: Arduino logo

III.3.2. Materials used:

To operate our smart glasses to fulfill the functions attributed to them, we will specify below the various Arduino materials that we used.

And now we will talk about the materials that we used to create these glasses. We used Arduino Uno card connected to a Bluetooth HC-05 and an Arduino camera OV7670.

III.3.2.1 Arduino Uno card:

III.3.2.1.1 Description:

Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller.

The Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output. It allows the designers to control and sense the external electronic devices in the real world. [3]

III.3.2.1.2. Technical specification:

- Microcontroller : ATmega38P – 8 bit AVR family microcontroller
- Operating Voltage : 5V
- Recommended Input Voltage : 7-12V
- Input Voltage Limits : 6-20V
- Analog Input Pins : 6 (A0-A5)
- Digital I/O Pins : 14 (Out of which 6 provide PWM output)
- DC Current on I/O Pins: 40mA
- DC Current on 3.3V Pin: 50mA
- Flash Memory : 32 KB (0.5 KB is used for Bootloader)
- SRAM : 2kB
- EEPROM : 1kB
- Frequency (Clock Speed) : 16MHz

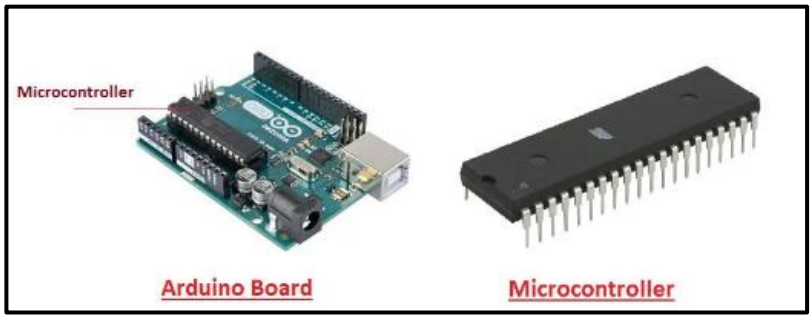


Figure III.4: Arduino Uno. [3]

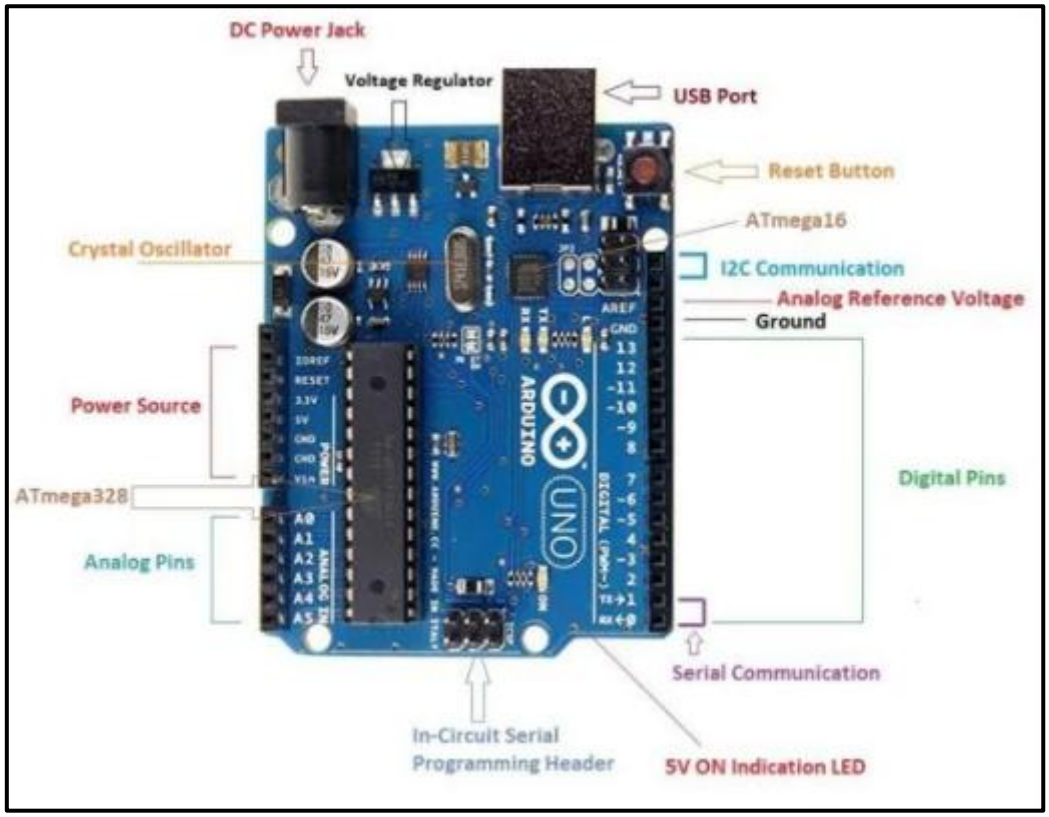


Figure III.5: Arduino pins

III.3.2.2. Camera OV7670:

III.3.2.2.1. Description:

The **OV7670** image sensor is a simple VGA camera and image processor for use with microcontrollers such as the Arduino. The camera supports a max resolution of 640 x 480 and maximum frame rate of 30 frames per second. Users have complete control over image quality, data format, and transmission. [4]

Figure III.6: Camera OV7670. [5]

III.3.2.2.2. Technical specification:

- Photo sensitive Array: 640 x 480.
- IO Voltage: 2.5V to 3.0V.
- Operating Power: 60mW/15fpsVGAYUV.
- Sleeping Mode: <20µA.
- Operating Temperature: -30 to 70 deg C.
- Output Format: YUV/YCbCr4:2:2 RGB565/555/444 GRB4:2:2 Raw RGB Data (8 digit).
- Lens Size: 1/6″.
- Vision Angle: 25 degree.
- Max. Frame Rate: 30fps VGA.
- Sensitivity: 1.3V / (Lux-sec).
- Signal to Noise Ratio: 46 dB.
- Dynamics Range: 52 dB.
- Browse Mode: By row.
- Electronic Exposure: 1 to 510 row.
- Pixel Coverage: 3.6µm x 3.6µm.
- Duck Current: 12 mV/s at 60℃.
- PCB Size (L x W): Approx. 1.4 x 1.4 inch / 3.5 x 3.5 cm. [5]

We connect the OV7670 Arduino camera module with Arduino UNO card based on the following electronic diagram:

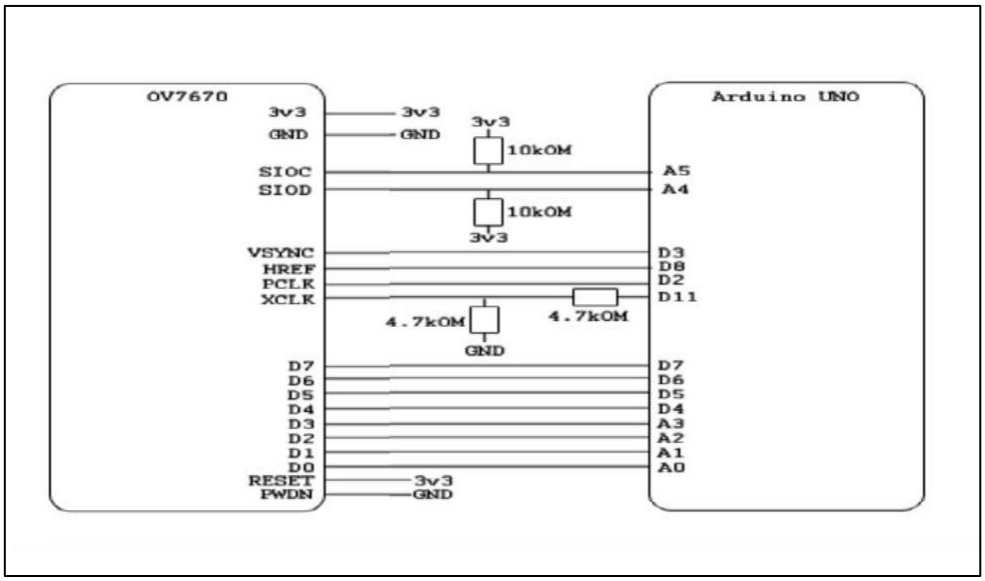


Figure III.7: Electronic diagram

III.3.2.3. Bluetooth HC-05:

III.3.2.3.1. Description:

The HC-06 Bluetooth module is used to establish a Bluetooth link (serial link) between an Arduino board and another device with a Bluetooth connection (Smartphone, tablet, second Arduino board, etc...). The HC-05 module is a “slave” module unlike the HC-05 module which is a “master”. A “master” module can ask another Bluetooth element to pair with it while a “slave” module can only receive pairing requests. [6]

III.3.2.3.2. Technical specification:

- Frequency : 2.4GHz ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Emission power : ≤4dBm, Class 2
- Sensitivity : ≤-84dBm at 0.1% BER
- Speed : Asynchronous communication : 2.1Mbps (Max) / 160 kbps, Synchronous communication : 1Mbps/1Mbps
- Security : Authentication and encryption
- Profiles : Bluetooth serial port
- Supply Voltage : +3.3V to 6.0 V

- Supply Current : 30mA
- Working temperature : -20 ~ +75Centigrade
- Dimension : 26.9mm x 13mm x 2.2 mm. [7]

Figure III.8: Bluetooth HC-06

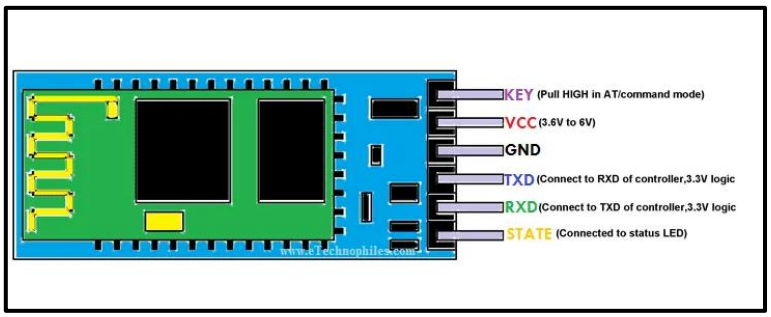


Figure III.9: HC-05 Pinout. [7]

III.3.2.4. Launching camera OV7670:

For launching the camera to take pictures, we most connect the Arduino card with laptop using USB cable, go to “Tools” in Arduino IDE program and select the serial port from it “com1” on our case, then we check the code from “Sketch➔check” after that we upload the code to the Arduino Uno card from “Sketch➔upload”. The camera will take pictures and send it to phone via BT.

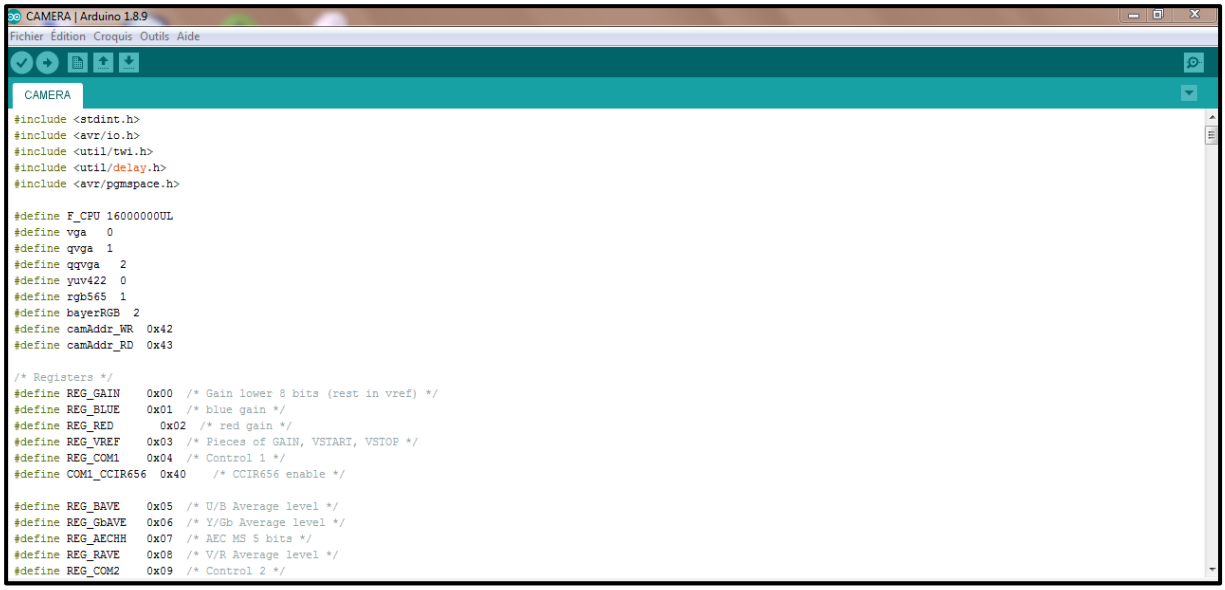


Figure III.10: Arduino program -piece of code-

III.3.3. Android :

III.3.3.1. Description :

Android is an open source, Linex-based operating system for mobile devices such as smartphones and tablet computers. Android developed by the open Handset/Alliance, led by Google, and other companies.

Figure III.11: Android logo

III.3.3.2. Android Studio:

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrain's IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems or as a subscription-based service in 2020. It is a replacement for the Eclipse Android Development Tools (E-ADT) as the primary IDE for native Android application development.

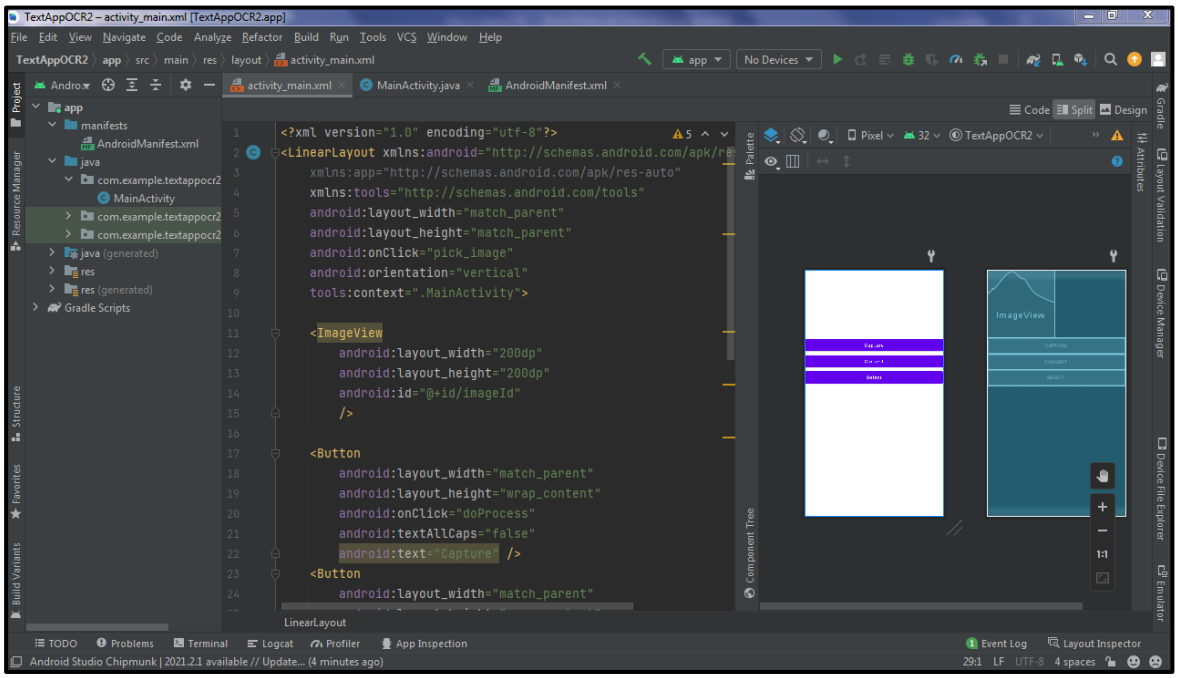


Figure III.12: Interface of android studio

III.3.4. OCR Firebase ML kit:

III.3.4.1. Firebase ML kit:

Firebase ML Kit It is a mobile SDK that enables Android and iOS app developers to have advanced machine learning capabilities into their apps with ease.

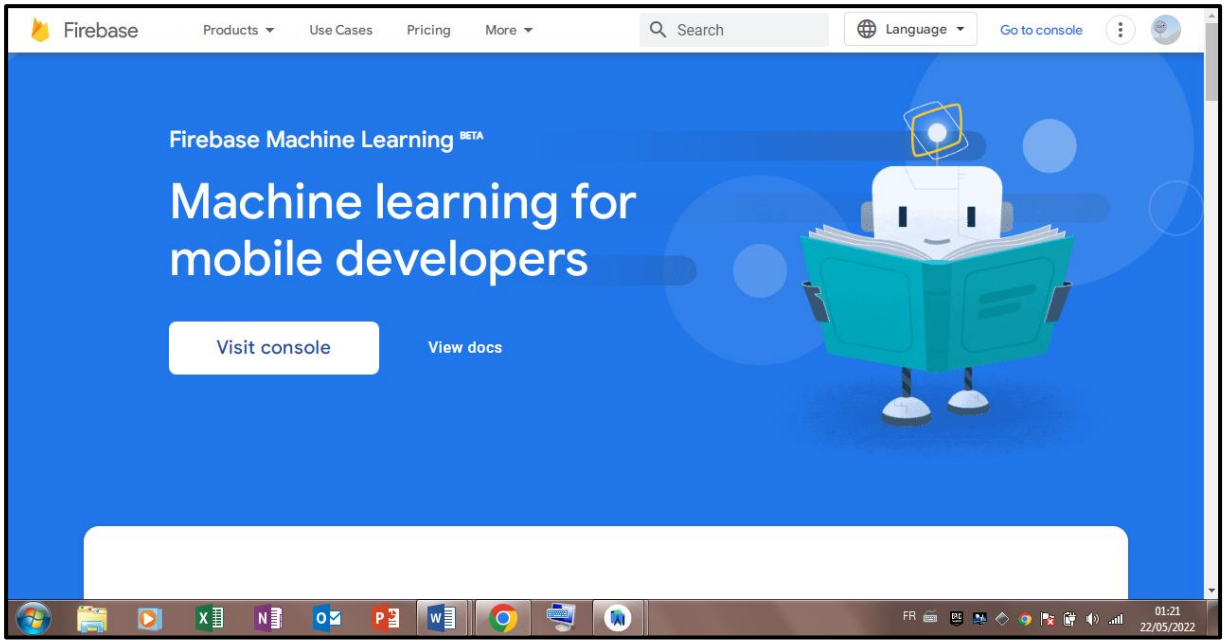


Figure III.13: Firebase interface

III.3.4.2. Firebase text recognition:

Text Recognition is the process of detecting and recognizing of textual information in images, videos, documents and other sources.

With ML Kit's Text Recognation API, you can recognize text in any Latin based language (and more, with cloud-based text recognition).

Figure III.14: OCR ML Kit detecting text

III.4. Our realization:

III.4.1. Our glasses shape:

Here we will show the final shape of our smart glasses.

Figure III.15: Our smart glasses.

III.4.2. Facing the glasses:

We face the glasses to the text we want to read like the picture bellow:

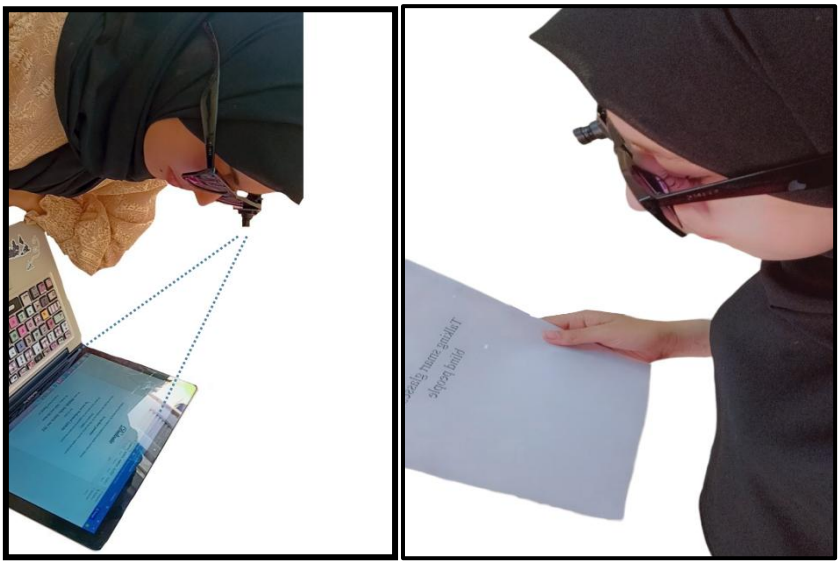


Figure III.16: Facing the glasses to text.

III.4.3. Capturing image:

The camera OV7670 on the glasses will take a picture of the text in the front of it.

This is a test of how the image appears from camera OV7670:

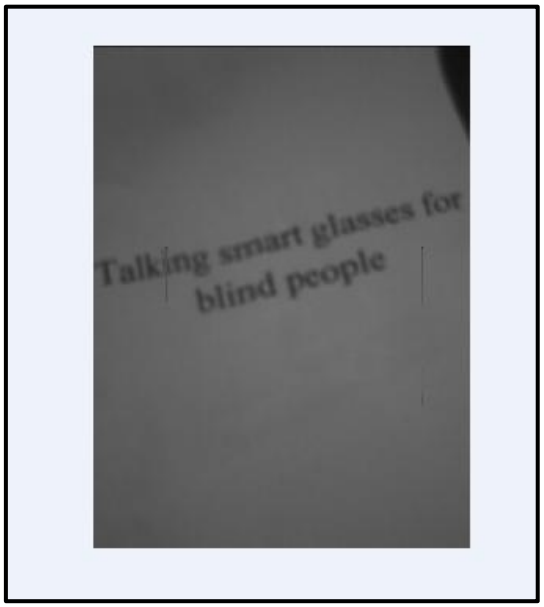


Figure III.17: Example of image taken.

III.4.4. Using firebase ML kit:

In our application, for detecting text or OCR we use ML kit from Firebase.

We connect our application to Firebase and its call directly it's library, and add the activity to the Manifast class in our android application and bellow is the code for doing it:

```
Bundle bundle = data.getExtras();
//from bundle, extract the text
bitmap = (Bitmap) bundle.get("data");
// set in imageView
imageView.setImageBitmap(bitmap);}
// process the image
//1. create a FirebaseVisionImage object from a Bitmap object
FirebaseVisionImage firebaseVisionImage = FirebaseVisionImage.fromBitmap(bitmap);

// 2. get an instance of FirebaseVision
FirebaseVision firebaseVision = FirebaseVision.getInstance();
//3. create an instance of FirebaseVisionTextRecognizer
FirebaseVisionTextRecognizer firebaseVisionTextRecognizer = firebaseVision.getOnDeviceTextRecognizer();
//4. create a task to process the image
Task<FirebaseVisionText> task = firebaseVisionTextRecognizer.processImage(firebaseVisionImage);
//5. if task is success
task.addOnSuccessListener(new OnSuccessListener<FirebaseVisionText>() {
```

Figure III.18: Firebase OCR ML kit- piece of code**.**

III.4.5. Android application interface:

The captured image is processed in this application represented bellow, as it contains two zones, the first one (A) is for the image and the second (B) is for the text extracted from it. It also contains buttons that enable us to choose an image from the gallery.

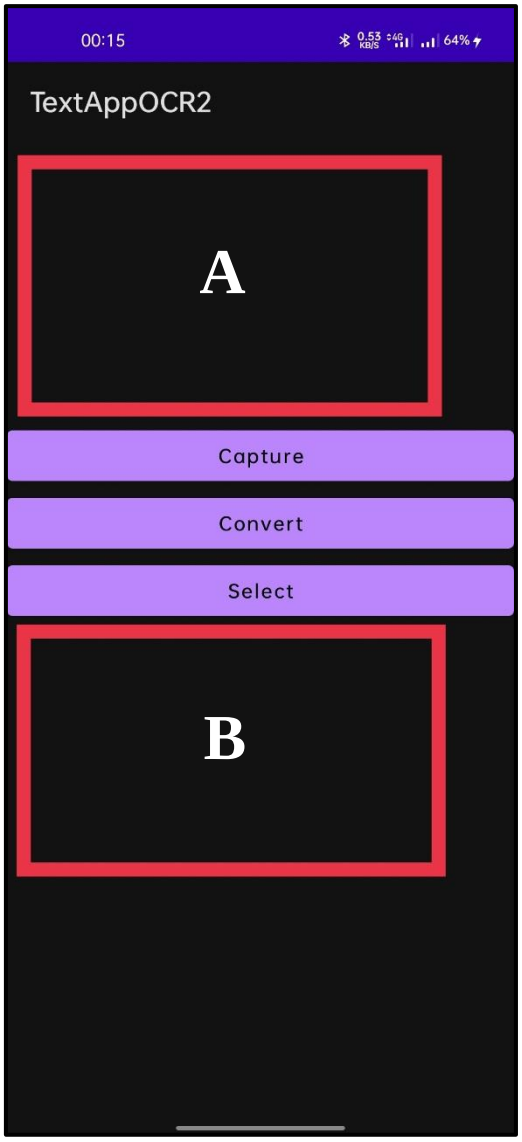


Figure III.19: Android application interface.

III.4.6. Text Extraction:

When the application receive the image by BT will show it in the zone (A) in our android application and extract the text from it directly and put it in the zone (B), after that the blind or the illiterate person will hear the voice into his ears.

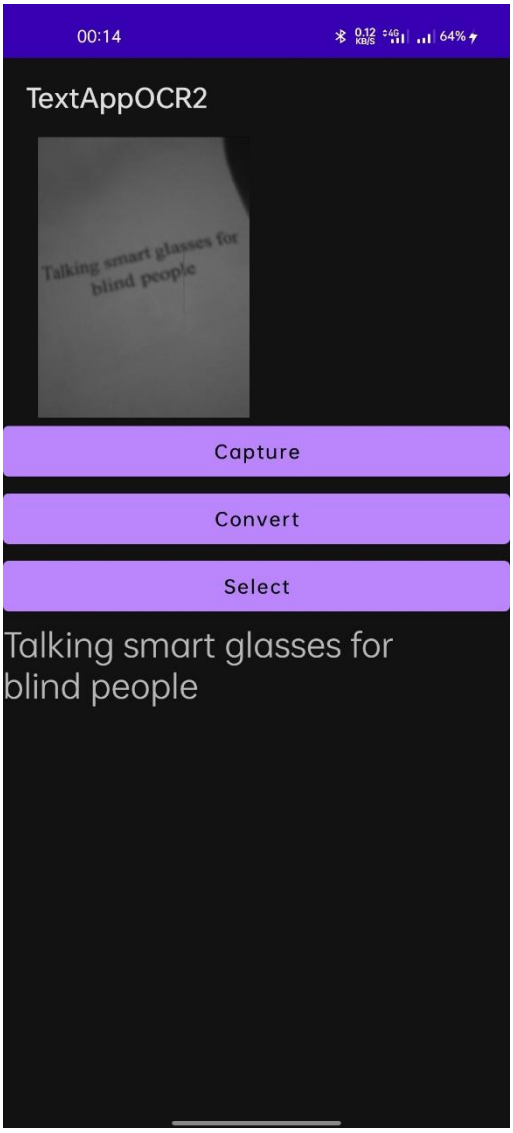


Figure III.20: Extracting text from the image.

III.4.7. Text-to-Speech:

We can convert text to voice with Text-to-Speech and hear it, that last one is one of android studio features, than both of blind or illiterate person can hear the text in front of them.

```
public void onSuccess(FirebaseVisionText firebaseVisionText) {
  String s = firebaseVisionText.getText();
  textView.setText(s);
    textToSpeech = new TextToSpeech(getApplicationContext(),
            new TextToSpeech.OnInitListener() {
                @Override
                public void onInit(int i) {
                    if (i == TextToSpeech.SUCCESS)
                    {
                        //selecting language
                        int lang = textToSpeech.setLanguage(Locale.ENGLISH);

                    }
                    else
                    {
                        int lang = textToSpeech.setLanguage(Locale.FRANCE);
                    }
                }
            });
    convert.setOnClickListener(new View.OnClickListener() {
```

Figure III.21: Piece of code- convert text-to-speech.

III.5. Conclusion:

In this chapter, we presented the objectives and the conception working of the project, then we moved to presenting the various means (programs and tools) used to accomplish this project and our realization and how our smart glasses works.

General conclusion

General conclusion:

When we preparing the graduation project, we tried to apply the knowledge gained in our university studies to design and implement smart glasses. The goal of this project was to design a smart device to recognize patterns that solves the problems that blind people as well as the illiterate (reading) suffer from.

This project was implemented in two parts:

The first is to develop a program that will be placed in the Arduino card to allow image capture. The second is the phone application to communicate with this card, where it recognizes the text in the captured images and converts it to speech.

It should be noted that faced some difficulties in identifying the images automatically but we can say that despite these difficulties, the results obtained through this study are satisfactory and with more advanced tools, the result will be better.

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