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Smart Eyes

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قال تعالى:

﴿ ...فَإِنَّهَا لَا تَعْمَى الْأَبْصَارُ وَلَٰكِن تَعْمَى الْقُلُوبُ الَّتِي فِي الصُّدُورِ ﴾

الحج :٤٦

صدق الله العظيم

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We would also like to thank our families who give us the ability to finalize this project, for their love, understanding, encouragement, and confidence in us.

Abstract

This project shows a low cost, fixable and available tool for blinds –people who can't see – using an embedded system based on a microcontroller (Raspberry pi 3 model B) with many interfaces to the web such as Wi-Fi, Bluetooth and USBs, to allow many choices when it comes to connect to the internet, this tool will allow the blind to get a brief description about the view around them, and answer them about many questions such as the time, that's makes it a part of internet of things (IoT). This tool based on many software components such as cloud services, hardware components too, such as camera to take the pictures, ultrasonic to measure the distance between the blind and the obstacles in front of them, all of that working with a low need of power.

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Chapter one

Introduction

1.1 Introduction:

Due to the huge development in the technical world and the appearance of new techniques day after day like machine learning, image processing, artificial intelligence as a software side and hardware side represented by smart chips like micro-computers, it became easy to employ these techniques to serve the humanity. In this project we'll use some of these techniques in order to produce a tool to serve blind people. We use a micro-computer 'raspberry pi 'and a camera connected to it, we chose this chip for many reasons which will be discussed in the next chapters. All of these chips works together to achieve the goals. Many problems made us feel this responsibility and duty towards disabled layer of society. As a result of scientific development in this field of computer technology, which has been linked closely to people's lives where he presented a lot of facilities and solutions for many problems, as we are involved in this important area as a student's keen to provide and sum up our education and our knowledge to develop a tool to help the blind to solve some of problems which they are exposed, to make a window of hope to them. This tool will make the blind's life easier and help them in many circumstances that may face them. By using this tool, the blinds can do almost what normal persons do. This tool base on a system depends on a cloud and image processing to analysis the taken photos from the client and compare it with millions of stored photos at the servers. The mechanism of smart eyes glasses is as fallowing; the blind takes a photo for a scene in the environment by a camera witch connected to a micro-computer. The micro-computer sends the photo to a server in order to analyze the photo and then get the result of analyzing and convert it to a voice format.

There is a sensor connected to the micro-computer in purpose to estimate the distance between the blind and the objects in order to avoid crushing. The sensor gives an intention when the distance is less than one meter.

1.2 Problem Statement

Using eyes, person can distinguish between the surrounding objects, differentiate between them and indulge in the practice of life naturally. So this work is a tool that assists blind and involve them in public life while reducing their need for others. The person who lost his sight is located in many problems including psychological, social and physical health problems. Psych problems such as the Blind's

feeling of inferiority form other people, leading to the generation of a state of psychological depression and frustration, so it is vulnerable to ridicule and derision by others. Social problems such as The blind become dependent on others, and Health problems like that is Possible to eat toxic or harmful food, leading to his illness. Be vulnerable to the problems of traffic like fall in drilling or collision resulting in injury.

The blindness is a problem itself and it cause another problem like:

1. Lack of the technologies used to serve blinds.
2. The high price of the exist tools.
3. As we knew the blind can't see as a result blinds may face problems and difficulties In life.
4. Some problems and difficulties are.
5. blinds can collide with the things.
6. blinds don't know the number of people in front of him.
7. blinds don't know the objects in front of him.
8. blinds Can't read the papers.

1.3 Goals

The major objective is to develop an embedded system called smart eyes to help blinds and reduce his/her suffering through the following:

- Helps the blinds to get description of the surrounding objects.
- Allows the blinds to know the age and gender of the people around them.
- Allows the blind to know the content of documents.
- Warns the blind before collision with objects.

1.4 Research Scope:

1.4.1 Geographical Scope:

This system can be used in any place of the world the blind can access to the internet from it.

1.4.2 Functional Scope:

The system will be able to:

1. Describe what is in front of the blind and sent it as a sound.
2. Describe the faces in front of the blind and sent a sound of the ages and gender and the emotions of them.
3. Read the papers to the blind.

4. Warm the blind before make a collision with objects around him.

1.5 Methodology:

We used waterfall methodology to build this embedded system because the requirements are well defined and it is a medium in size.

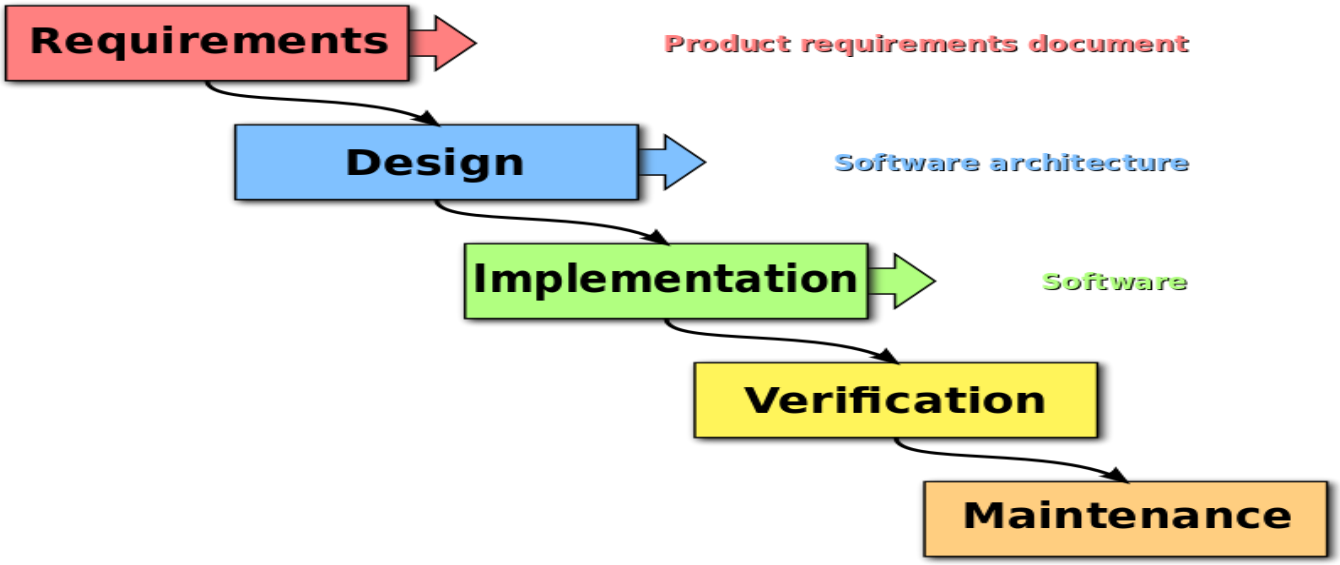


Figure 1.1 the methodology

1.6 Tools:

1.6.1 Software Tools:

Table 1.1 shows the software tools that used in this project.

The tool	usage
1. Raspbian	Operating system of the raspberry pi chip.
2. Python 2.7	Editor used to write the code.
3. Python 3.5	Editor used to write the code.
4. Cloud services	To process the requests from client.

5. Libraries.	To do some prevailing instruction to the hardware

1.6.2 Hardware Tools:

Table 1.2 shows the hardware tools that used in this project.

The tool	usage
1. Raspberry pi 3	Micro-computer act as a client use the cloud services
2. Raspberry pi camera	To take photos
3. Power Bank	Supply electricity
4. Raspberry pi camera cable	Transform the photos to the micro-computer
5. Ultrasonic sensor	Meager the distance
6. Display	To display the graphical process in the raspberry pi
7. Laptops	3 laptops
8. Buttons	To allow the user to click and control the system

1.7 The Plan:

ID	Task Mode	WBS	Task Name	Duration	Start	Finish	Predecessors
1		1	**Smart Eye for blind**	186.13 days	T 27/09/16	T 18/05/17	
2		1.1	**Conceptualize and initialize project**	1.1 mons	S 01/10/16	T 03/11/16	
3		1.1.1	Define Research Problem	1 day?	T 27/09/16	W 28/09/16	
4		1.1.2	Identify Project's Goals	1 day?	W 28/09/16	T 29/09/16	٣
5		1.1.3	Identify and analyze alternatives	5 days	S 01/10/16	W 05/10/16	٤
6		1.1.4	Define feasibility	0.63 days	T 06/10/16	T 06/10/16	٥
7		1.1.5	Deliver over-all framework v1	0 days?	T 03/11/16	T 03/11/16	
8		1.1.6	Buy Chips	1 day?	W 02/11/16	T 03/11/16	٦
9		1.2	**Planing**	4 days?	S 14/05/17	T 18/05/17	
10		1.2.1	Identify project scop	1 day?	S 14/05/17	M 15/05/17	٧
11		1.2.2	Identefy project schedual	1 day?	M 15/05/17	T 16/05/17	١٠
12		1.2.3	Identify resources	1 day?	T 16/05/17	W 17/05/17	
13		1.2.4	Identify and analyze Risks	1 day?	W 17/05/17	T 18/05/17	١١;١٢
14		1.2.5	Deliver over-all framework v2	0 days?	T 18/05/17	T 18/05/17	
15		1.3	**Execute Project**	2 days?	T 16/05/17	T 18/05/17	
16		1.3.1	**Planing**	2 days?	T 16/05/17	T 18/05/17	
17		1.3.1.1	Identify tasks	1 day?	T 16/05/17	W 17/05/17	١١
18		1.3.1.2	Assigne responsbilities	1 day?	W 17/05/17	T 18/05/17	١٧
19		1.3.2	**Analysis**	1 day?	W 17/05/17	T 18/05/17	
20		1.3.2.1	**Define Literature Review**	1 day?	W 17/05/17	T 18/05/17	
21		1.3.2.1.1	Analyze previous studies	1 day?	W 17/05/17	T 18/05/17	٣;٤
22		1.3.2.1.2	literature Review Prepration	1 day?	W 17/05/17	T 18/05/17	
23		1.3.2.1.3	Deliver Literature review document	1 day?	W 17/05/17	T 18/05/17	
24		1.3.2.2	**Requirment Specification**	1 day?	W 17/05/17	T 18/05/17	
31		1.3.2.3	**Modeling**	1 day?	W 17/05/17	T 18/05/17	
32		1.3.2.4	**SRS deliverabl**	1 day?	W 17/05/17	T 18/05/17	

Project: Project2.0.mpp
Date: S 21/05/17

Task		External Milestone		Manual Summary Rollup	
Split		Inactive Task		Manual Summary	
Milestone		Inactive Milestone		Start-only	
Summary		Inactive Summary		Finish-only	
Project Summary		Manual Task		Deadline	
External Tasks		Duration-only		Progress	

ID	Task Mode	WBS	Task Name	Duration	Start	Finish	Predecessors
33		1.3.3	**Desgin**	1 day?	W 17/05/17	T 18/05/17	
34		1.3.3.1	System Desgin	1 day?	W 17/05/17	T 18/05/17	
35		1.3.3.2	Architecture Desgin	1 day?	W 17/05/17	T 18/05/17	
36		1.3.3.3	Detailed desgin	1 day?	W 17/05/17	T 18/05/17	
37		1.3.3.4	**layout Desgin**	1 day?	W 17/05/17	T 18/05/17	
38		1.3.3.4.1	Interfaces desgin	1 day?	W 17/05/17	T 18/05/17	
39		1.3.3.5	Deliver SDD	0 days	T 18/05/17	T 18/05/17	
40		1.3.4	**Impelementation**	1 day?	W 17/05/17	T 18/05/17	
41		1.3.4.1	coding	1 day?	W 17/05/17	T 18/05/17	
42		1.3.5	**testing**	1 day?	W 17/05/17	T 18/05/17	
43		1.3.5.1	**Testing Plan**	1 day?	W 17/05/17	T 18/05/17	
44		1.3.5.1.1	Determine scope , risks and identify objectives	1 day?	W 17/05/17	T 18/05/17	
45		1.3.5.1.2	Determine the test approach	1 day?	W 17/05/17	T 18/05/17	
46		1.3.5.1.3	Determine the required test resources	1 day?	W 17/05/17	T 18/05/17	
47		1.3.5.1.4	Schedule the following phases	1 day?	W 17/05/17	T 18/05/17	
48		1.3.5.1.5	Determine the exit criteria	1 day?	W 17/05/17	T 18/05/17	
49		1.3.5.2	**Test analysis and design**	1 day?	W 17/05/17	T 18/05/17	
50		1.3.5.2.1	Review the test basis	1 day?	W 17/05/17	T 18/05/17	
51		1.3.5.2.2	Identify test conditions	1 day?	W 17/05/17	T 18/05/17	
52		1.3.5.2.3	Design the tests	1 day?	W 17/05/17	T 18/05/17	
53		1.3.5.2.4	Design the test environment	1 day?	W 17/05/17	T 18/05/17	
54		1.3.5.3	**Test implementation and execution**	1 day?	W 17/05/17	T 18/05/17	
55		1.3.5.3.1	Implementation	1 day?	W 17/05/17	T 18/05/17	
56		1.3.5.3.1.1	Develop and prioritize test cases	1 day?	W 17/05/17	T 18/05/17	

Project: Project2.0.mpp
Date: S 21/05/17

Task		External Milestone		Manual Summary Rollup	
Split		Inactive Task		Manual Summary	
Milestone		Inactive Milestone		Start-only	
Summary		Inactive Summary		Finish-only	
Project Summary		Manual Task		Deadline	
External Tasks		Duration-only		Progress	

ID	Task Mode	WBS	Task Name	Duration	Start	Finish	Predecessors
57		1.3.5.3.1.2	Create test suites	1 day?	W 17/05/17	T 18/05/17	
58		1.3.5.3.1.3	Implement and verify the environment	1 day?	W 17/05/17	T 18/05/17	
59		1.3.5.3.2	Execution	1 day?	W 17/05/17	T 18/05/17	
60		1.3.5.3.2.1	Execute the test suites and individual test cases	1 day?	W 17/05/17	T 18/05/17	
61		1.3.5.3.2.2	Log the outcome of test execution	1 day?	W 17/05/17	T 18/05/17	
62		1.3.5.3.2.3	Compare actual results with expected results	1 day?	W 17/05/17	T 18/05/17	
63		1.3.5.4	Evaluating exit criteria and reporting	1 day?	W 17/05/17	T 18/05/17	
64		1.3.5.4.1	Check test logs against the exit criteria specified in test planning	1 day?	W 17/05/17	T 18/05/17	
65		1.3.5.4.2	Assess if more tests are needed	1 day?	W 17/05/17	T 18/05/17	
66		1.3.5.4.3	Write a test summary report	1 day?	W 17/05/17	T 18/05/17	
67		1.3.5.5	Test closure activities	1 day?	W 17/05/17	T 18/05/17	
68		1.3.6	Deliver Software	1 day?	W 17/05/17	T 18/05/17	
69		1.4	Close Project	1 day?	W 17/05/17	T 18/05/17	
70		1.4.1	Conclusions and Recumendations	1 day?	W 17/05/17	T 18/05/17	
71		1.4.1.1	Conclusions	1 day?	W 17/05/17	T 18/05/17	
72		1.4.1.2	Recumendations	1 day?	W 17/05/17	T 18/05/17	
73		1.4.2	Final Report and Decumentation	0 days	T 18/05/17	T 18/05/17	
74		1.5	Evaluate Project	1 day?	W 17/05/17	T 18/05/17	

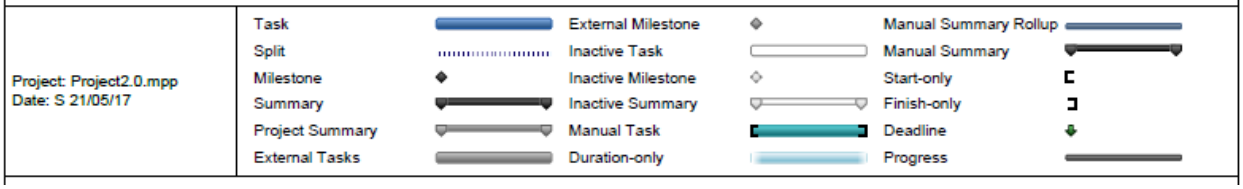


Figure 1.7 the plan

1.8 The Research Organization:

As the chapter one which outlines the essential points of this project, chapter started an introduction and overview about the technologies that we have used to deliver this tool, chapter three will discuss the system analysis and try to get the full description of what we are about to do, requirement specification, use cases and many other diagrams, chapter four transcribe the analysis results into a design we can, a diagrams we can get many information from it helping in the next chapter, sequence, class and stat chart diagrams, chapter five will discuss the implementation and the techniques that you should have to build such an embedded system like this one, chapter six will give the conclusion and the recommendations also the future usage.

Chapter two

Literature Review

2.1 Introduction

Due to the huge advanced in many technological areas, Hardware, Software and Cloud, all of these techniques have made what seemed imagination be fact, using these areas many applications and embedded systems is created to make the human life's easier when using them in daily lives, in work, at home, even when they moving from one place to another. these techniques used in many sciences, but a little used in humanist side so the major aim of this project is to draw attention to this side of the society especially the blinds, so we are going to need an embedded system that use these techniques to alleviates the trouble of the blinds in their lives, so using image processing, cloud and perfect hardware everyone can give the helping hand to this side of society.

2.2 Techniques Can Solve The Problem

2.2.1 Arduino

Is an open-source prototyping platform based on easy-to-use hardware and software. Arduino provides an open-source and easy-to-use programming tool, for writing code and uploading it to your board. It is often referred to as the Arduino IDE (Integrated Development Environment).

The Arduino boards are able to read inputs - light, proximity or air quality on a sensor, or an SMS or Twitter message - and turn it into an output - activating a motor, turning on a light, publishing content online or trigger external events. You can tell your board what to do by writing code and uploading it to the microcontroller on it using the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has powered thousands of projects. Arduino has gathered around a community where beginners and experts from around the world share ideas, knowledge and their collective experience. There are thousands of makers, students, artists, designers, programmers, researchers, professionals and hobbyists worldwide who use Arduino for learning, prototyping, and finished professional work production.

Arduino was born at the Interaction Design Institute Ivrea IDII from the Wiring project as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. The main objective of both projects is to make the process of working with technology and electronics easier. The Arduino board has evolved to adapt to new needs ranging from simple 8-bit boards to products ready for IoT applications. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their

particular needs. The software is open-source, and it is growing through the contributions of developers and the Arduino community worldwide.

There have been many similar projects, but none of them succeeded as well as Arduino has, due to how easy it is to use the software, and the affordability of the hardware. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced user's needs. It runs on Mac, Windows, and Linux.

2.2.1.1 Arduino IDE

As shown in figure (2.1) Arduino provides an open-source and easy-to-use programming tool for writing code and uploading it to your board. It is often referred to as the Arduino IDE (Integrated Development Environment). The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users. The Arduino Software (IDE) is cross-platform, it runs on Windows, Mac OSX, and Linux operating systems. You can tell your board what to do by writing code and uploading it to the microcontroller on it using the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. The Arduino software is published as open source tools, available for contribution by programmers worldwide. The language can be extended through C/C++ libraries and ported to other hardware platforms. [1]

Figure(2.1): Arduino

2.2.2 Banana Pi

The Banana Pi is a series of credit card-sized single-board computers based on a low cost concept for inner software and hardware development and school software learning such as Scratch. Its hardware design was influenced by Raspberry Pi in 2013. It is produced by the Chinese company Shenzhen SINOVOIP Co.,Ltd.

Banana Pi software is compatible with Raspberry Pi boards. Banana Pi also can run NetBSD, Android, Ubuntu, Debian, Arch Linux, Raspbian operating systems, though the CPU complies with the requirements of the Debian armhf port. It uses the Allwinner SoC (system on chip) and as such is mostly covered by the linux-sunxi port.

As shown in figure (2.2) Banana Pi is the open source hardware and software platform which is designed to assist bananapi.org and banana-pi.org.There are many banana pi boards like Banana Pi M2 Ultra Banana Pi BPI-M2 Ultra is a quad-core mini single board computer built with Allwinner R40 SoC. It features 2GB of RAM and 8GB eMMC. It also has onboard Wi-Fi and BT. On the ports side, the BPI-M2 Ultra has 2 USB A 2.0 ports, 1 USB OTG port, 1 HDMI port, 1 audio jack, a DC power port Also being a member of the Banana Pi family, the M2 Ultra is a direct upgrade from the Banana Pi M1/M1+ that support SATA from the SoC. The SATA performance on the R40 is fitting for media related projects such as storage servers. Backed by our community, starting a project and building servers is fun and rewarding. We welcome all companies, DIYers, and tech loving people within our community! Together, we can make a difference, we can discover our passions, inspire others, and build a practical project so the most popular banana pi until now is Banana Pi M2 Ultra [2].

Figure(2.2): BananaPI

2.2.3 **Raspberry Pi**

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. Several generations of Raspberry Pis have been released. The first generation (Raspberry Pi 1 Model B) was released in February 2012. It was followed by a simpler and inexpensive model Model A. In 2014, the foundation released a board with an improved design in Raspberry Pi 1 Model B+. The model laid the current "mainline" form-factor. Improved A+ and B+ models were released a year later. A cut down "compute module" was released in April 2014, and a Raspberry Pi Zero with smaller size and limited input/output (I/O) and general-purpose input/output (GPIO) abilities was released in November 2015 for US$5. The Raspberry Pi 2 which added more RAM was released in February 2015. Raspberry Pi 3 Model B released in February 2016 is bundled with on-board Wi-Fi and Bluetooth. As of December 2016, Raspberry Pi 3 Model B is the newest mainline Raspberry Pi. These boards are priced between US$5–35.

The Raspberry Pi 3 is the third generation Raspberry Pi. It replaced the Raspberry Pi 2 Model B in February 2016 see figure (2.3). Compared to the Raspberry Pi 2 it has:

1) A 1.2GHz 64-bit quad-core ARMv8 CPU
2) 802.11n Wireless LAN
3) Bluetooth 4.1
4) Bluetooth Low Energy (BLE)

Like the Pi 2, it also has:

1) 1GB RAM
2) USB ports
3) 40 GPIO pins
4) Full HDMI port
5) Ethernet port
6) Combined 3.5mm audio jack and composite video
7) Camera interface (CSI)
8) Display interface (DSI)
9) Micro SD card slot (now push-pull rather than push-push)
10) VideoCore IV 3D graphics core

Figure(2.3): Raspberry Pi

2.2.4 **Comparison Between Arduino, Raspberry Pi And Banana Pi**

Table (2.1) shows the features and specifications of each board in many sides and the

Item	Discription		
Board	Raspberry pi	Banana Pi	Arduino
Board Image			
Lastest Model	Raspberry pi 3 module B	Banana Pi M2 U	Arduino Mega
Height	(56.5 mm)	(60 mm)	(53.3 mm)
Width	(85.6 mm)	(92 mm)	(53.6 mm)
Weight	(45 g)	(48 g)	(37 g)
CPU	1.2GHz 64-bit quad-core ARMv8	Quad Core ARM Cortex A7 CPU. R40.	16MHz ATmega32P
RAM	1GB	2GB	2KB
Ethernet (LAN, RJ45)	10/100 Ethernet	10/100/1000 Ethernet	
USB	4x USB2.0 + micro OTG	2x USB2.0 + micro OTG	1USB
HDMI port	Yes	Yes	No
Wi-Fi	Yes	Yes	No

Bluetooth®	Yes	Yes	No
GPIO	40 Pin	26 Pin	60 Pin
Audio	3.5mm	3.5mm	No
Optics	16-pin MIPI Camera Serial Interface	Camera connector	No
Operating system	Raspbian, Windows IoT…etc. .	Debian,Windows IoT …etc.	No
Usage and Handle	Hard	Hard	Easy
Price	35$	80$	38.8$

2.2.4.1 **Conclusion**

While the Banana Pi may have been a notable improvement over Raspberry Pi and Arduino but the lack of support for Banana Pi board, along with the higher price tag, makes raspberry pi 3 better in many situations. Banana pi have storage through SATA, but you can find all of banana pi features in raspberry pi without much trouble.

2.3 **Why Raspberry Pi**

Raspberry pi board based on BCM2837 board so it's provide many feature and allowed to add a build in hardware like WIFI and Bluetooth and a power full processor, raspberry pi is fully supported in the forms and many project have been done using the raspberry pi chip, likewise the Arduino is supported too but the comparison between this tow board isn't fair, also the price of this tow is reasonable unlike the banana pi where the price of banana pi is more than raspberry pi or Arduino where the price up to double with a leak of support and many problems can show up during the work, Raspberry Pi has lots of online resources , Raspberry pi has many plug and play type 3rd party interface boards(sensor kits, camera modules and many other breakout board), so as a result of that, many technical project done using raspberry pi rather other boards.

2.4 **History Of Raspberry Pi**

When the declining of numbers and skills of students applying for Computer Science became a concern for a team that included Eben Upton, Rob Mullins, Jack Lang and Alan Mycroft at the University of Cambridge's Computer Laboratory in 2006, a need for a tiny and affordable computer came to their minds. Several versions of the early Raspberry Pi prototypes were designed but were very limited by the high cost and low power processors for mobile devices at that time.

In 2008, the team started a collaboration with Pete Lomas, MD of Norcott Technologies and David Braben, the co-author of the seminal BBC micro game Elite, and formed the Raspberry Pi Foundation. Three years later, the Raspberry Pi Model B was born and it had sold over two million units within in two years of mass production.

The products were so popular due to their cost ranging from $25 – $35 (£17 – £23) they were efficient and durable which made them easy to modify and crate projects on, The device ran Linux a popular OS for developers due to it being open-source.

2.4.1 Overview in BCM2837, BCM43438 AND RASPBERRY PI 3

For Raspberry Pi 3, Broadcom have supported us with a new SoC, BCM2837. This retains the same basic architecture as its predecessors BCM2835 and BCM2836, so all those projects and tutorials which rely on the precise details of the Raspberry Pi hardware will continue to work. The 900MHz 32-bit quad-core ARM Cortex-A7 CPU complex has been replaced by a custom-hardened 1.2GHz 64-bit quad-core ARM Cortex-A53. Combining a 33% increase in clock speed with various architectural enhancements, this provides a 50-60% increase in performance in 32-bit mode versus Raspberry Pi 2, or roughly a factor of ten over the original Raspberry Pi.

James Adams spent the second half of 2015 designing a series of prototypes, incorporating BCM2837 alongside the BCM43438 wireless "combo" chip. He was able to fit the wireless functionality into very nearly the same form-factor as the Raspberry Pi 1 Model B+ and Raspberry Pi 2 Model B; the only change is to the position of the LEDs, which have moved to the other side of the SD card socket to make room for the antenna. Roger Thornton ran the extensive (and expensive) wireless conformance campaign, allowing us to launch in almost all countries simultaneously. Phil Elwell developed the wireless LAN and Bluetooth software.

All of the connectors are in the same place and have the same functionality, and the board can still be run from a 5V micro-USB power adapter. This time round, we're recommending a 2.5A adapter if you want to connect power-hungry USB devices to the Raspberry Pi. [3][4]

2.5 Raspberry Pi Board Versions

2.5.1 Raspberry Pi Zero:

The Raspberry Pi Zero is half the size of a Model A+, with twice the utility as shown in figure (2.4).

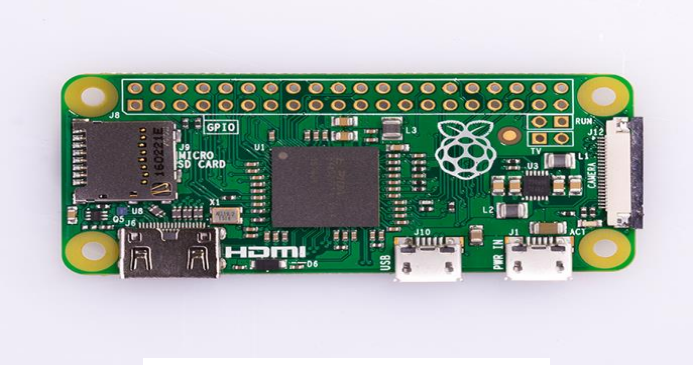


Figure (2.4) Raspberry pi zero

A tiny Raspberry Pi that's affordable enough for any project!

- 1Ghz, Single-core CPU
- 512MB RAM
- Mini HDMI and USB On-The-Go ports
- Micro USB power
- HAT-compatible 40-pin header
- Composite video and reset headers
- CSI camera connector (v1.2 only)

2.5.2 Raspberry Pi 1 Model A:

2.5.2.1 Model A:

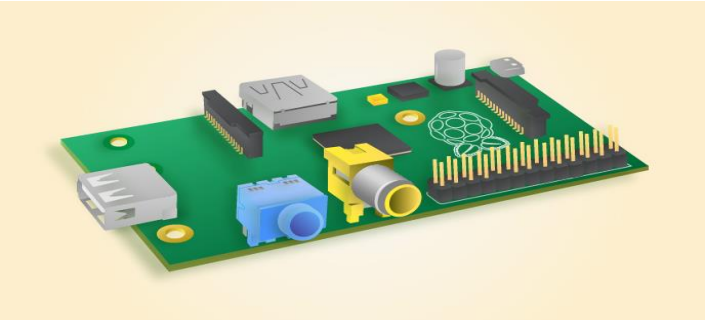


Figure (2.5) Raspberry pi Model A

Model A is the lower-spec variant of the Raspberry Pi, with 256 MB of RAM, one USB port and no Ethernet port as shown in figure (2.5) .

This model is usually bought for embedded projects: because it's missing a few ports and an Ethernet chip, the Model A is lighter and consumes less power than a Model B. We see a lot of Model As used in robotics; and also in projects where weight and low power are paramount, such as the very popular high-altitude ballooning high-jinks pioneered by Dave Akerman, and now being reproduced in schools around the world. Model A in combination with a Wi-Fi dongle is also ideal for users who just want a Raspberry Pi to act as a media center running behind their television.

2.5.2.2 Model A+:

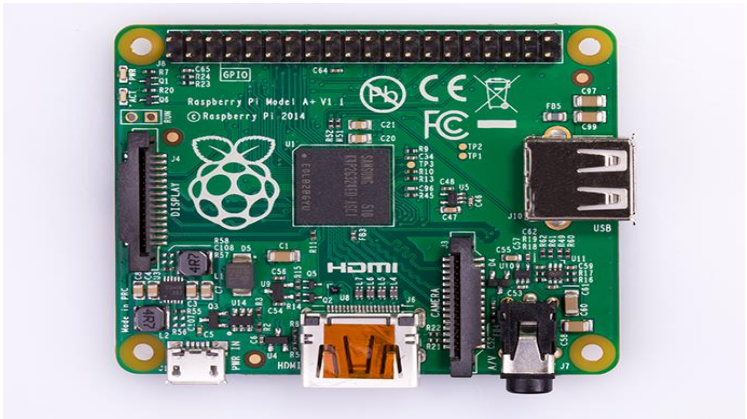


Figure (2.6) Raspberry pi Model A+

As shown in figure (2.6) The Model A+ is the low-cost variant of the Raspberry Pi. It replaced the original Model A in November 2014. Compared to the Model A it has:

- **More GPIO**. The GPIO header has grown to 40 pins, while retaining the same pinout for the first 26 pins as the Model A and B.

- **Micro SD**. The old friction-fit SD card socket has been replaced with a much nicer push-push micro SD version.
- **Lower power consumption**. By replacing linear regulators with switching ones we've reduced power consumption by between 0.5W and 1W.
- **Better audio**. The audio circuit incorporates a dedicated low-noise power supply.
- **Smaller, neater form factor.** We've aligned the USB connector with the board edge, moved composite video onto the 3.5mm jack, and added four squarely-placed mounting holes. Model A+ is approximately 2cm shorter than the Model A.

2.5.3 Raspberry Pi Model B:

2.5.3.1 Raspberry pi 2 Model B:

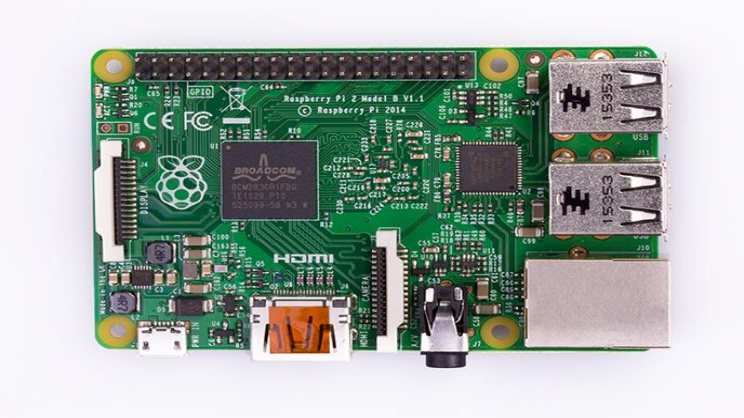


Figure (2.7) Raspberry pi 2 Model B

The Raspberry Pi 2 Model B is the second generation Raspberry Pi.

it has:

- A 900MHz quad-core ARM Cortex-A7 CPU
- 1GB RAM

Like the (Pi 1) Model B+, it also has:

- 4 USB ports
- 40 GPIO pins
- Full HDMI port

- Ethernet port
- Combined 3.5mm audio jack and composite video
- Camera interface (CSI)
- Display interface (DSI)
- Micro SD card slot
- VideoCore IV 3D graphics core

Because it has an ARMv7 processor, it can run the full range of ARM GNU/Linux distributions, including Snappy Ubuntu Core, as well as Microsoft Windows 10

2.5.3.2 Raspberry Pi 3 Model B:

Figure (2.8) Raspberry pi 3 Model B

The Raspberry Pi 3 is the third generation Raspberry Pi. It replaced the Raspberry Pi 2 Model B in February 2016. The Raspberry Pi 3 has an identical form factor to the previous Pi 2 (and Pi 1 Model B+) and has complete compatibility with Raspberry Pi 1 and 2.We recommend the Raspberry Pi 3 Model B for use in schools, or for any general use. Those wishing to embed their Pi in a project may prefer the Pi Zero or Model A+, which are more useful for embedded projects, and projects which require very low power see figure (2.8). [5]

2.6 Specifications:

The specification of the use Raspberry pi in this project.

2.6.1 Hardware:

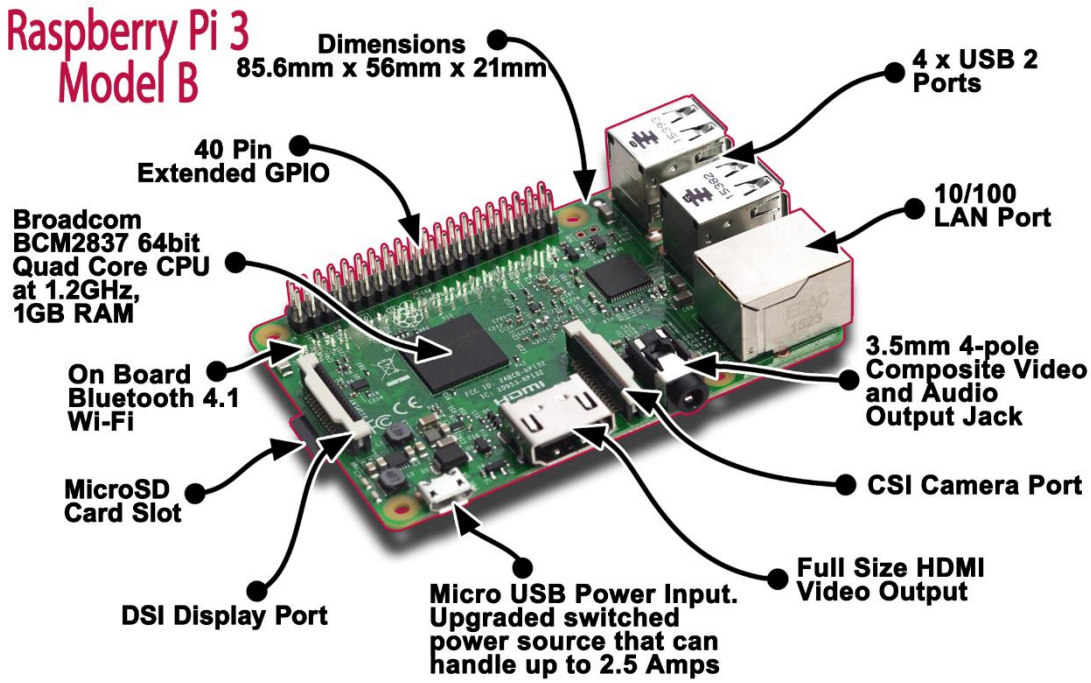


Figure (2.9) Raspberry pi 3 Model B

- A 1.2GHz 64-bit quad-core ARMv8 CPU
- 802.11n Wireless LAN
- Bluetooth 4.1
- Bluetooth Low Energy (BLE)
- 40 GPIO pins
- 1GB RAM
- 4 USB ports
- Full HDMI port
- Ethernet port
- Combined 3.5mm audio jack and composite video
- Camera interface (CSI)
- Display interface (DSI)
- Micro SD card slot (now push-pull rather than push-push)
- VideoCore IV 3D graphics core

Wireless radio

So small, its markings can only be properly seen through a microscope or magnifying glass, the Broadcom BCM43438 chip provides 2.4GHz 802.11n wireless LAN, Bluetooth Low Energy, and Bluetooth 4.1 Classic radio support. Cleverly built directly onto the board to keep costs down, rather than the more common fully qualified module approach, its only unused feature is a disconnected FM radio receiver.

Antenna

There's no need to connect an external antenna to the Raspberry Pi 3. Its radios are connected to this chip antenna soldered directly to the board, in order to keep the size of the device to a minimum. Despite its diminutive stature, this antenna should be more than capable of picking up wireless LAN and Bluetooth signals – even through walls.

SoC

Built specifically for the new Pi 3, the Broadcom BCM2837 system-on-chip (SoC) includes four high-performance ARM Cortex-A53 processing cores running at 1.2GHz with 32kB Level 1 and 512kB Level 2 cache memory, a VideoCore IV graphics processor, and is linked to a 1GB LPDDR2 memory module on the rear of the board.

GPIO

The Raspberry Pi 3 features the same 40-pin general-purpose input-output (GPIO) header as all the Pis going back to the Model B+ and Model A+. Any existing GPIO hardware will work without modification; the only change is a switch to which UART is exposed on the GPIO's pins, but that's handled internally by the operating system.

USB chip

The Raspberry Pi 3 shares the same SMSC LAN9514 chip as its predecessor, the Raspberry Pi 2, adding 10/100 Ethernet connectivity and four USB channels to the board. As before, the SMSC chip connects to the SoC via a single USB channel, acting as a USB-to-Ethernet adaptor and USB hub.

2.6.2 Software:

The original Raspberry Pi has always had a few different operating systems (OSs) available, albeit most of them based on Linux. With the release of the Raspberry Pi 3 a few more are starting to appear. The reason behind this is that most Linux operating systems are written to run on the ARMv8 architecture (the CPU at the center of the Raspberry Pi). The original Pi's CPU was based on ARMv6. It is therefore becoming much easier for operating systems to be ported to the Pi3 So Raspberry pi 3 have a more than enough of hardware to run an operating system.

The Raspberry Pi itself doesn't come with an operating system. For that, you need **NOOBS**, short for New Out of the Box Software. It's an operating system manager that makes it easy to download, install, and set up your Raspberry Pi. When you first boot up NOOBS, you'll get a selection of OSes to choose from. Which operating systems are available depends on which model of Raspberry Pi you are using.

So first we need the NOOBS to stat up the raspberry pi then you can install any other operating system or any Linux distribution , A 'distribution' is the word that is often used to describe a flavour of Linux, and probably came about when users used to 'distribute' sets of CDs with the operating system and applications on them, so when you finish downloading NOOBS and you start up the raspberry pi the first interface will show up is this, and we should select one of these operating systems figure (2.19) shows the first interface of NOOBS.

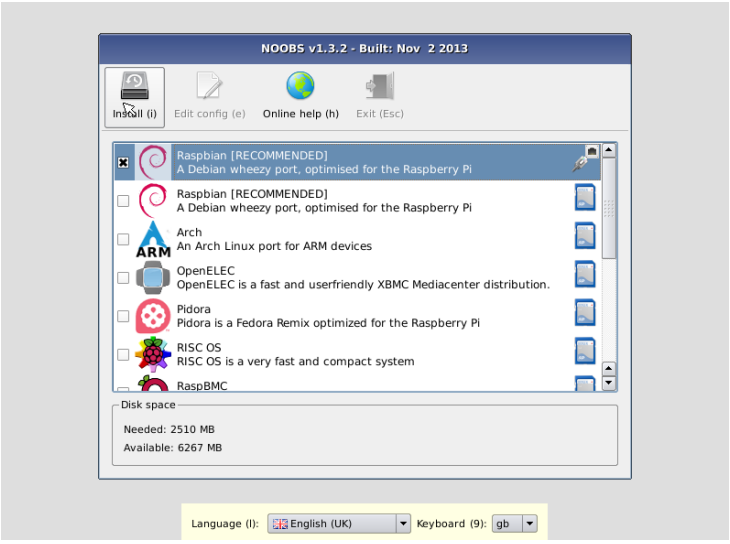


Figure (2.10) NOOBS OS

2.6.2.1 Raspberry Pi Operating Systems:

After we have been installed the NOOBs we can install many operating systems on raspberry pi, some of this operating system are based on Linux but the other aren't.

2.6.2.1.1 Raspbian OS:

A free Debian-based OS optimized for Raspberry Pi's hardware, Raspbian comes with all the basic programs and utilities you expect from a general-purpose operating system. Supported officially by the Raspberry foundation, this OS is popular for its fast performance and its more than 35,000 packages figure (2.11) shows the Raspbian OS Desktop.

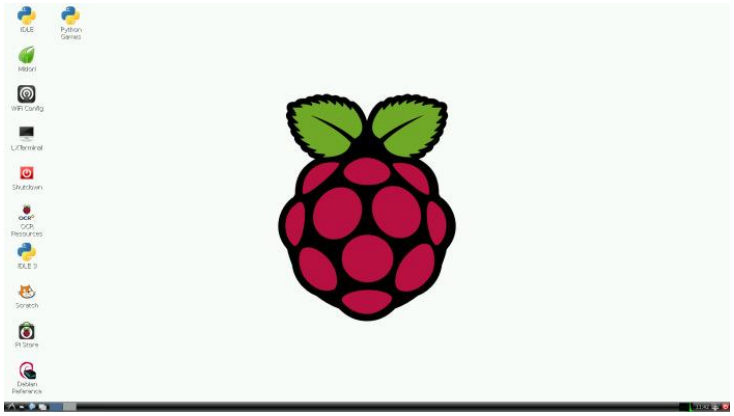


Figure (2.11) Raspbian OS

2.6.2.1.2 Ubuntu MATE:

Ubuntu MATE is a stable and simple OS, which brings a configurable yet still light-on-resources MATE desktop for its users. It is especially good for devices short on hardware specs, making it perfect for Raspberry Pi devices that can't run a composite desktop. MATE desktop comes with essential apps like a file manager, text editor, image viewer, system monitor, document viewer and terminal, Figure (2.12) shows Ubuntu MATE OS.

Figure (2.12) Ubuntu MATE

2.6.2.1.3 Windows 10 IoT:

Windows 10 IoT is a special version of Windows built for the Raspberry Pi. It is not a full version of Windows. Instead, it's meant as a development platform for coders and programmers to prototype internet connected devices using the Raspberry Pi and Windows 10. Windows 10 IoT is only compatible with Windows 10 and you cannot do anything with it unless you have another computer with Windows 10 installed figure (2,13) shows the main menu of windows 10 IOT core.

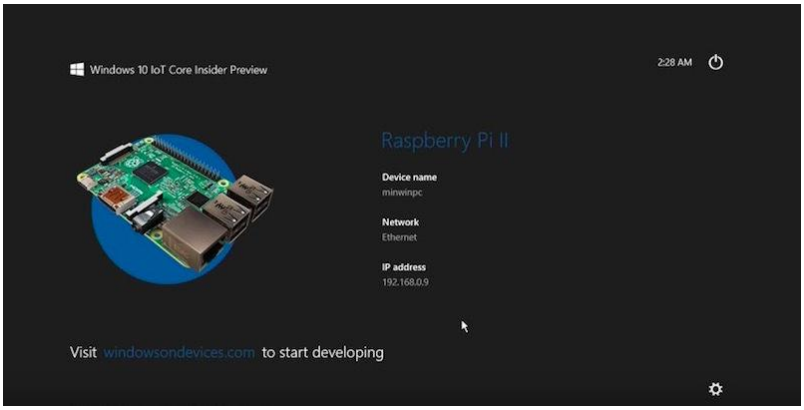
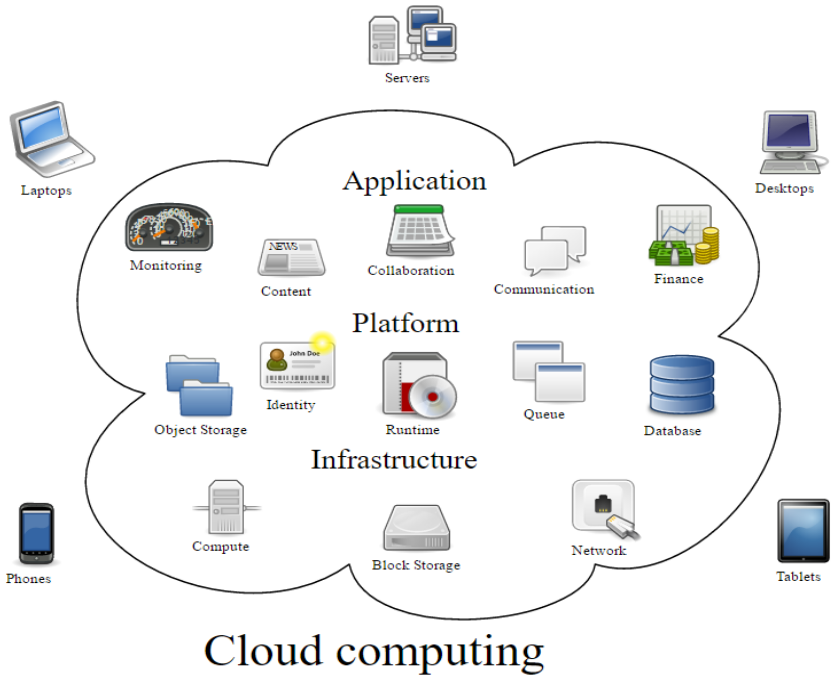


Figure (2.13) Windows 10 IoT OS

And there are many other operating systems like , OSMC, OpenELEC and RISC OS,Kali Linux,CentOS …etc.

2.7 Cloud Computing:

cloud computing is the delivery of computing services—servers, storage, databases, networking, software, analytics, and more—over the Internet ("the cloud"). Companies offering these computing services are called cloud providers and typically charge for cloud computing services based on usage, similar to how you're billed for water or electricity at home [16].



2.7.1 Top Benefits Of Cloud Computing:

Cloud computing is a big shift from the traditional way businesses think about IT resources. What is it about cloud computing? Why is cloud computing so popular? Here are 6 common reasons organizations are turning to cloud computing services:

1. Cost

Cloud computing eliminates the capital expense of buying hardware and software and setting up and running on-site datacenters—the racks of servers, the round-the-clock electricity for power and cooling, the IT experts for managing the infrastructure. It adds up fast.

2. Speed

Most cloud computing services are provided self service and on demand, so even vast amounts of computing resources can be provisioned in minutes, typically with just a few mouse clicks, giving businesses a lot of flexibility and taking the pressure off capacity planning.

3. Global scale

The benefits of cloud computing services include the ability to scale elastically. In cloud speak, that means delivering the right amount of IT resources—for example, more or less computing power, storage, bandwidth—right when its needed, and from the right geographic location.

4. Productivity

On-site datacenters typically require a lot of "racking and stacking"—hardware set up, software patching, and other time-consuming IT management chores. Cloud computing removes the need for many of these tasks, so IT teams can spend time on achieving more important business goals.

5. Performance

The biggest cloud computing services run on a worldwide network of secure datacenters, which are regularly upgraded to the latest generation of fast and efficient computing hardware. This offers several benefits over a single corporate datacenter, including reduced network latency for applications and greater economies of scale.

6. Reliability

Cloud computing makes data backup, disaster recovery, and business continuity easier and less expensive, because data can be mirrored at multiple redundant sites on the cloud provider's network [16].

2.7.2 Types Of Cloud Services: Iaas, Paas, Saas:

Most cloud computing services fall into three broad categories: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (Saas). These are sometimes called the cloud computing stack, because they build on top of one another. Knowing what they are and how they're different makes it easier to accomplish your business goals [16].

2.7.2.1 Infrastructure-as-a-service (IaaS)

The most basic category of cloud computing services. With IaaS, you rent IT infrastructure—servers and virtual machines (VMs), storage, networks, operating systems—from a cloud provider on a pay-as-you-go basis. To learn more [16].

2.7.2.2 Platform as a service (PaaS)

Platform-as-a-service (PaaS) refers to cloud computing services that supply an on-demand environment for developing, testing, delivering, and managing software applications. PaaS is designed to make it easier for developers to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network, and databases needed for development [16].

2.7.2.3 Software as a service (SaaS)

Software-as-a-service (SaaS) is a method for delivering software applications over the Internet, on demand and typically on a subscription basis. With SaaS, cloud providers host and manage the software application and underlying infrastructure, and handle any maintenance, like software upgrades and security patching. Users connect to the application over the Internet, usually with a web browser on their phone, tablet, or PC [16].

2.7.3 How cloud computing works

Cloud computing services all work a little differently, depending on the provider. But many provide a friendly, browser-based dashboard that makes it easier for IT professionals and developers to order resources and manage their accounts. Some cloud computing services are also designed to work with REST APIs and a command-line interface (CLI), giving developers multiple options. [6]

2.7.4 Why Cloud Computing

Cloud computing opens a new world for the developers, using cloud, Applications will get another meaning, reliability, efficiency, intelligent, and security all of this preference criteria will be added to these applications. the availability of high-capacity networks, low-cost computers and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture, and autonomic and utility computing led to a growth in cloud computing["Cloud Computing: Clash of the clouds". The Economist. 2009-10-15. Retrieved 2009-11-03.], it was reported that cloud computing had become a highly demanded service or utility due to the advantages of high computing power, cheap cost of services, high performance, scalability, accessibility as well as availability. Some cloud vendors are experiencing growth rates of 50% per year, but being still in a stage of infancy, it has pitfalls that need to be addressed to make cloud computing services more reliable and user friendly["The economy is flat so why are financials Cloud vendors growing at more than 90 percent per annum?". FSN. March 5, 2013.] [16].

2.7.5 Cloud Services

The must two popular vendors of cloud services are Google and Microsoft these companies have some cloud services, services like computer vision services and cloud storage services.

2.7.5.1 Microsoft Cloud Services (Microsoft Cognitive Services)

Microsoft Cognitive Services (formerly Project Oxford) are a set of APIs, SDKs and services available to developers to make their applications more intelligent, engaging and discoverable. Microsoft Cognitive Services expands on Microsoft's evolving portfolio of machine learning APIs and enables developers to easily add intelligent features – such as emotion and video detection; facial, speech and vision recognition; and speech and language understanding – into their applications. Our vision is for more personal computing experiences and enhanced productivity aided by systems that increasingly can see, hear, speak, understand and even begin to reason all of these services are based on REST [15].

2.7.5.1.1 Computer Vision API

The cloud-based Computer Vision API provides developers with access to advanced algorithms for processing images and returning information. By uploading an image or specifying an image URL, Microsoft Computer Vision algorithms can analyze visual content in different ways based on inputs and user choices. With the Computer Vision API users can analyze images. The Computer Vision API provides state-of-the-art algorithms to process images and return information. For example, it can be used to determine if an image contains mature content, or it

can be used to find all the faces in an image. It also has other features like estimating dominant and accent colors, categorizing the content of images, and describing an image with complete English sentences. Additionally, it can also intelligently generate images thumbnails for displaying large images effectively.

2.7.5.1.2 Emotion API

The Emotion API beta takes an image as an input, and returns the confidence across a set of emotions for each face in the image, as well as bounding box for the face, from the Face API. The emotions detected are happiness, sadness, surprise, anger, fear, contempt, disgust or neutral. These emotions are communicated cross-culturally and universally via the same basic facial expressions, where are identified by Emotion API.

Emotion Recognition

Recognizes the emotions expressed by one or more people in an image, as well as returns a bounding box for the face. The emotions detected are happiness, sadness, surprise, anger, fear, contempt, and disgust or neutral. The supported input image formats includes JPEG, PNG, GIF(the first frame), BMP. Image file size should be no larger than 4MB. If a user has already called the Face API, they can submit the face rectangles as an optional input. otherwise, Emotion API will first compute the rectangles. The detectable face size range is 36x36 to 4096x4096 pixels. Faces out of this range will not be detected. For each image, the maximum number of faces detected is 64 and the faces are ranked by face rectangle size in descending order. If no face is detected, an empty array will be returned. Some faces may not be detected due to technical challenges, e.g. very large face angles (head-pose), large occlusion. Frontal and near-frontal faces have the best results. The emotions contempt and disgust are experimental.

2.7.5.1.3 Face Detection

Face API detects up to 64 human faces with high precision face location in an image. And the image can be specified by file in bytes, face detection extracts a series of face related attributes such as pose, gender, age, head pose, facial hair and glasses. Refer to Face - Detect for more details.

Detect human faces in an image and returns face locations, and optionally with faceIds, landmarks, and attributes.

- Optional parameters for returning faceId, landmarks, and attributes. Attributes include age, gender, smile intensity, facial hair, head pose and glasses. faceId is for other APIs

use including Face - Identify, Face - Verify, and Face - Find Similar. The faceId will expire in 24 hours after detection call.

- JPEG, PNG, GIF (the first frame), and BMP are supported. The image file size should be larger than or equal to 1KB but no larger than 4MB.
- The detectable face size is between 36x36 to 4096x4096 pixels. The faces out of this range will not be detected.
- A maximum of 64 faces could be returned for an image. The returned faces are ranked by face rectangle size in descending order.
- Some faces may not be detected for technical challenges, e.g. very large face angles (head-pose) or large occlusion. Frontal and near-frontal faces have the best results.
- Attributes (age, gender, headPose, smile, facialHair, and glasses) are still experimental and may not be very accurate. HeadPose's pitch value is a reserved field and will always return 0.

2.7.5.1.4 Limitation Of Microsoft Cognitive Services

1) No warranty. Microsoft provides the Service Components "as is," "with all faults," and "as available". Microsoft does not guarantee the suitability, reliability, availability, accuracy or timeliness of the Service Components or their output. Microsoft does not guarantee that availability of the Service Components will be uninterrupted, secure, error-free or that data loss will not occur.

2) You acknowledge that computer and telecommunications systems are not fault-free and occasional periods of downtime will occur. You acknowledge that Microsoft may provide the Service Components from another country or region, and that Microsoft does not guarantee availability in any specific country or region.

3) Microsoft gives no express warranties, guarantees, or conditions. Microsoft disclaims all warranties with regard to the Service Components. This includes any implied warranties (e.g., those of merchantability, fitness for a particular purpose, workmanlike effort, title, and non-infringement).

2.7.5.2 Google Cloud Vision

Google Cloud Vision API enables developers to understand the content of an image by encapsulating powerful machine learning models in an easy to use REST API [15]. It quickly classifies images into thousands of categories (e.g., "sailboat", "lion", "Eiffel Tower"), detects individual objects and faces within images, and finds and reads printed words contained within images. You can build metadata on your image catalog, moderate offensive content, or enable new marketing scenarios through image sentiment analysis. Analyze images uploaded in the request or integrate with your image storage on Google Cloud Storage.

Cloud Vision API Features

The Google Cloud Vision API has come out of Alpha and is now available in Beta with a basic pricing model in place. The API provides powerful image analysis that can help you perform a number of machine vision activities. We covered the initial announcement of the API late last year and the features have remained consistent since then. They include:

1) Optical Character Recognition that helps identify text in the image, including support for multiple languages.
2) Identify Explicit Content and thereby help filter out objectionable content
3) Label/Entity Detection which helps to identify the dominant entity/object in the image. This is very useful to classify a large amount of images. This is most likely the engine behind the recent Google Photos feature to identify / classify your images.
4) Landmark Detection that not just identifies the landmark but also provides other details like Latitude/Longitude.
5) Logo Detection that identifies any well-known logos in an image.
6) Facial Detection that will point out where the mouth, eyes, nose, etc are along with attributes to identify facial expressions. Google is very specific in stating that they do not support facial recognition and that the information is not saved on their servers.

2.7.5.3 conclusion

We have been selected the Microsoft cognitive services because it's return the reply in complete sentence and its mush support, Microsoft cognitive service is more suitable with this project but google cloud vision is more suitable with robotics projects.

2.7.6 Client Server Communication

Clients and servers exchange messages in a request–response messaging pattern. The client sends a request, and the server returns a response. This exchange of messages is an example of inter-process communication. To communicate, the computers must have a common language, and they must follow rules so that both the client and the server know what to expect. The language and rules of communication are defined in a communications protocol. All client-server protocols operate in the application layer. The application layer protocol defines the basic patterns of the dialogue. To formalize the data exchange even further, the server may implement an application programming interface (API). The API is an abstraction layer for accessing a service. By restricting communication to a specific content format, it facilitates parsing. By abstracting access, it facilitates cross-platform data exchange[10][11].

A server may receive requests from many distinct clients in a short period of time. A computer can only perform a limited number of tasks at any moment, and relies on a scheduling system to prioritize incoming requests from clients to accommodate them. To prevent abuse and maximize availability, server software may limit the availability to clients. Denial of service attacks are designed to exploit a server's obligation to process requests by overloading it with excessive request rates[11][12].

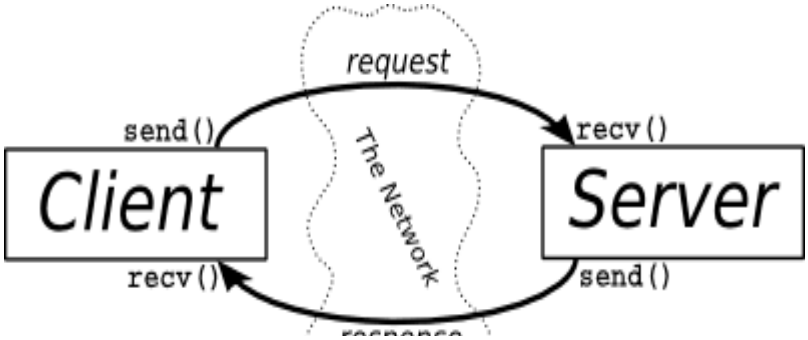


Figure (2.14) Client server Communication

2.8 Camera Pi

The Raspberry Pi Camera Module v2 replaced the original Camera Module in April 2016. The v2 Camera Module has a Sony IMX219 8-megapixel sensor (compared to the 5-megapixel OmniVision OV5647 sensor of the original camera).The Camera Module can be used to take high-definition video, as well as stills photographs. It's easy to use for beginners, but has plenty to offer advanced users if you're looking to expand your knowledge. There are lots of examples online of people using it for time-lapse, slow-motion, and other video cleverness. You can also use the libraries we bundle with the camera to create effects.You can read all the gory details about IMX219 and the Exmor R back-illuminated sensor architecture on Sony's website, but suffice to say this is more than just a resolution upgrade: it's a leap forward in image quality, colour fidelity, and low-light performance. It supports 1080p30, 720p60 and VGA90 video modes, as well as still capture. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi.The camera works with all models of Raspberry Pi 1, 2, and 3. It can be accessed through the MMAL and V4L APIs, and there are numerous third-party libraries built for it, including the Picamera Python library, figure (2.15) shows the camera pi module v2. [7]

Figure (2.15) Camera Pi module V2

2.9 Ultrasonic Sensor:

The HC-SR04 Ultrasonic Range Sensor uses non-contact ultrasound sonar to measure the distance to an object - they're great for any obstacle avoiding systems on Raspberry Pi, The HC-SR04 consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. The transmitters emit a high frequency ultrasonic sound, which bounce off any nearby solid objects, and the receiver listens for any return echo. That echo is then processed by the control

circuit to calculate the time difference between the signal being transmitted and received. This time can subsequently be used, along with some clever math, to calculate the distance between the sensor and the reflecting object. The HC-SR04 is great, as it's low cost, can be powered via the Raspberry Pi's 5V output, and is relatively accurate. The HC-SR04 has a 5V output (which needs to be reduced to 3.3V to work with the Raspberry Pi) as shown in figure (2.16).

Features:

- Operating Voltage: 5V DC
- Operating Current: 15mA
- Measure Angle: 15°
- Ranging Distance: 2cm - 4m

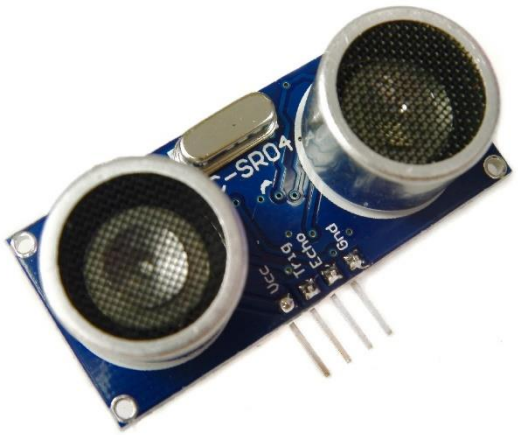


Figure (2.16) Ultrasonic sensor

2.10 Power Usage

The chip	The average power usage
Raspberry pi	300mA
Raspberry pi camera	250mA
Ultrasonic sensor	15mA
Total	565mA

2.11 Related Works:

1) GoPiGo robot car:

It's a robot used in teaching, this robot based on a raspberry pi, camera pi and ultrasonic sensor, this robot uses Google could vision. The disadvantage is the design of this robot that’s mean this robot didn't design to the blind slide of society and also this robot isn't wearable. [8]

2) Smart glasses based on pivothead glasses:

A research project that helps people who are visually impaired or blind to better understand who and what is around them. The project is built using intelligence APIs from Microsoft Cognitive Services.

The advantage: it's wearable, usability and well support.

The disadvantage: this system is an embedded system so the hardware that runs this system is expensive.

3) Insight system:

This system is created as graduate project at Faculty of Optics Sciences in Neelain University also this project based on raspberry pi and camera module but the main disadvantages are in design, also haven't a distance sensor or any sensor to measure the distance.

Chapter three

Analysis

3.1 Introduction

Generally, the embedded systems are often considered as critical systems such as (air plane system); it is may be strongly related to the human life –as medical system. In addition, embedded systems characterized as time-to-market systems Which required more controlling and focusing on all its life cycle stages /phases to accelerate the product delivery and reduce the cost. Analysis phase is important phase of the SDLC, such it details and describe the functions and the requirements of the system. And it illustrates the structure and the functionality of the system by the models created within it such as class diagram and use Case diagram.

This chapter is organized as following. Section 2 identifies the feasibility study. Data gathering is described in section 3. Section 4 specified user requirement and system requirement. Section 5 describe the modeling.

3.2 Feasibility Study:

An estimate is made of whether the identified user needs may be satisfied using current software and hardware technologies [8]. The purpose of feasibility is to define the potential solutions to the defined problem. Feasibility study will examine whether the system will be cost-effective and it's going to give the cost back as benefits.

3.2.1 Economic Feasibility:

Economic feasibility analysis is the most commonly used method for determining the efficiency of a new project. It is also known as cost analysis. It helps in identifying profit against investment expected from a project. Cost and time are the most essential factors involved in this field of study.

3.2.1.1 Intangible Benefits:

1. increase the blind's self-confidence.

2. Assistant blind to get integrated with society.

3.2.1.2 Hardware Cost:

3.2.1.2.1 One-Time Cost:

Table 3.1 the one-time cost.

The object	The cost
Development cost	500$
Hardware cost	100$

Software cost	70$
Total	670$

3.2.1.2.2 Recurrence Cost:

Table 3.2 the recurrence cost.

The operation	The cost
Operational cost	1 Megabyte/picture
Maintenance	Free
Power bank	Depends on usage

3.2.2 Technical Feasibility:

The Technical Feasibility Study assesses the details of how you will deliver a product or service (i.e., materials, labor, transportation, where your business will be located, technology needed, etc.).

The used resource in this project:

1. Three laptops.
2. Raspberry pi canKIT.
3. Distance sensor.
4. Cloud technologies.

3.2.3 Operational Feasibility:

The blind will use this tool without any background about how its work, this system is easy to use and what the blind have to do is clicking on the buttons.

The system has some operational cost like the internet connection cost during the usage and it's required a power bank.

3.3 Data Gathering:

There is a lot of deferent ways to get the data, research, papers, previous studies, the internet and field visits, the requirement get taken using field visits to many organizations that take care of blinds, also we used this data from different sources in implementation.

3.3.1 Field Visits

Because of the major aims of this project which is going to build to help the blinds, field visits are the best way to get the requirements so we visit some organizations asking many questions to discover the problems that faced the blinds.

3.3.2 The Internet

There a lot of technical problems and a lot of comparison that everybody needs to get them solved, so the best way is the internet and its different websites, so during the huge amount of information we learned how to dealing with the hardware chips and how to connect all of hardware chips, books and YouTube channels helped us too.

3.4 The Requirement Specification:

1) **User Requirements:**
   a) **Functional Requirement:**
      (1) The system should take a picture for a sense in the environment.
      (2) The system should send the taken image to the processing environment in order to analysis it.
      (3) The system should receive the result of the analyzing.
      (4) The system shall process the given result.
      (5) The system should return a description of the taken image.
      (6) The system should return a description of the human faces in image.
      (7) The system should read the text on the taken image for the bind.
      (8) The system should send an alarm to the blind before hitting any object.
      (9) The system should allow blind to know the time.
   b) **Nonfunctional Requirements:**
      (1) Speed of giving the results.

(2) Usability.

(3) Efficiency.

(4) Acceptability.

2) System Requirements:

a) Functional Requirements:

1. The system should take a picture for a sense in the environment.
   - 1.1 the blind press a button to take a picture.
   - 1.2 The system gives a feedback to the blind in a sound format to clearly that the button is get pressed.
   - 1.3 The system sends a machine instruction to the camera to take a picture.
   - 1.4 The system should store the taken picture in the specified path.
2. The system should send the taken image to the processing environment in order to analysis it.
   - 2.1 the system creates a socket connection and send the picture to the processing environment.
   - 2.2 the system changes the image format to binary.
   - 2.3 the system transmits the data image over the network.
3. The system should receive the result of the analyzing.
   - 3.1 the system keeps the connection in active state until it's receive the result.
   - 3.2 the system receives the result in particular format.
   - 3.3 the system should store the result in a variable stored in memory.
4. The system shall process the given result.
   - 4.1 the system converts the result that have been stored in memory into a text format.
   - 4.2 the system stores the converted result in a variable.
5. The system should return a description of the taken image.
   - 5.1 this function achieved by using the pervious function that specified above.
   - 5.2 The user clicks on description button and the system will take a picture for the view in front of the blind.

5.3 The picture gets analyzed and the result received by the system.

6. The system should return a description of the human faces in image.

6.1this function achieved by using the pervious function that specified above.

6.2 The user clicks on description button and the system will take a picture for the view in front of the blind.

6.3 The picture gets analyzed and the result received by the system.

7. The system should read the text on the taken image for the bind.

7.1 this function achieved by using the pervious function that specified above.

7.2 The user clicks on description button and the system will take a picture for the view in front of the blind.

7.3 The picture gets analyzed and the result received by the system.

8. The system should send an alarm to the blind before hitting any object.

8.1 the system sends an ultrasonic waves using an ultrasonic sensor.

8.2 the waves hit any object and that cause a reflection of this waves, this waves will receive by the same sensor.

8.3 the system masseur the distance using this waves.

8.4 if the distance equaled to 0.5 m the system will send an alarm to the blind using the head speakers

9. The system should allow blind to know the time.

9.1 the blind press a button.

9.2 the system will send the time to the blind as sound.

3.5 Modeling

3.5.1 Introduction

Usually models are used to deal with complexity through abstraction and graphical views. We use the UML-standard modeling language in software domain Which provide several graphical diagrams to show the system in deferent views. And it has been considered attractive to model complex embedded systems. This model contain one class diagram built to represent static and dynamic aspect of Smart Eyes system. The static view is represented by the class diagram illustrated in figure 3.3 and the dynamic view is represented by the sequences diagrams.

3.5.2 Block Diagram

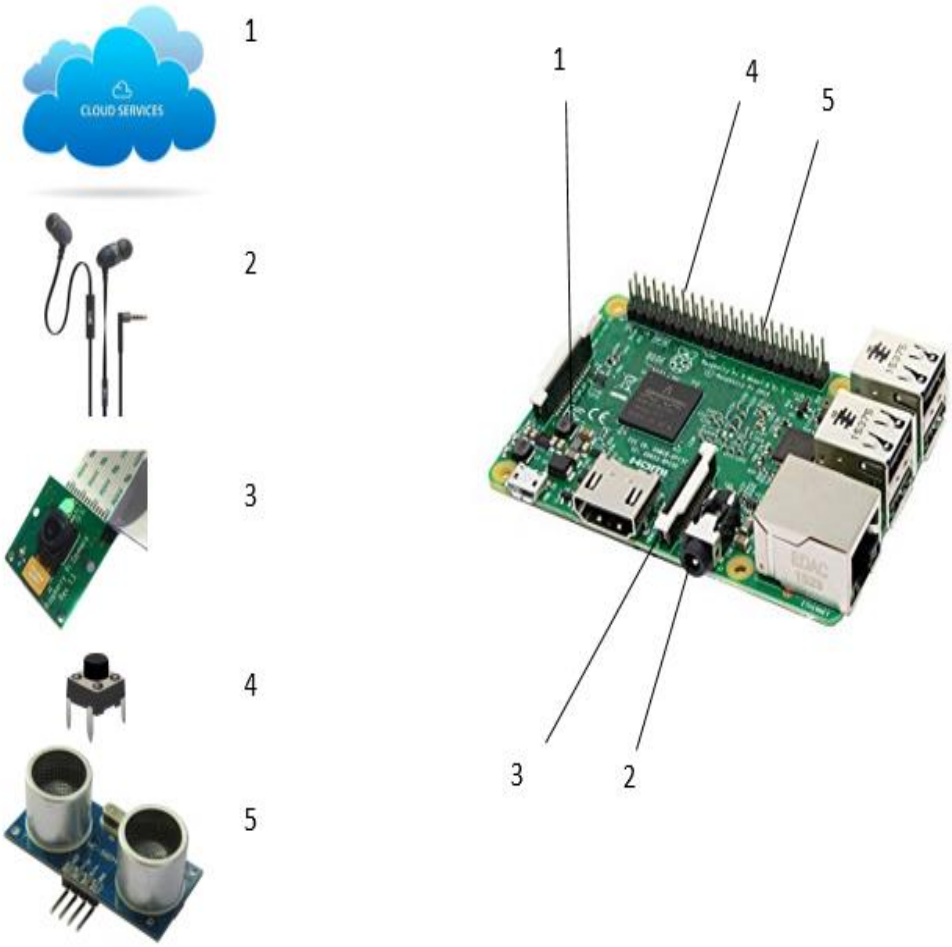


Figure (3.1): Block Diagram

3.5.3 Scenarios

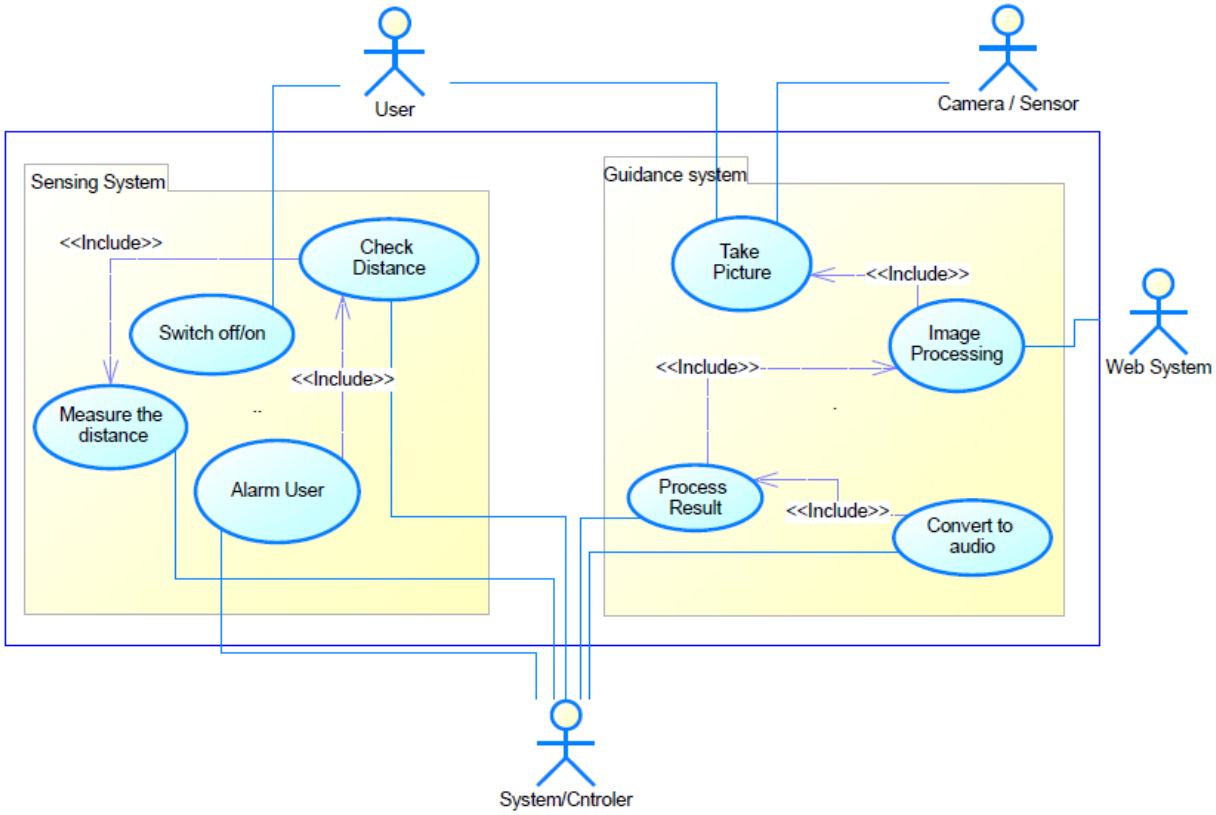
Scenario 1:

Smart eyes system is an embedded system it should allow the user to get information about the objects around him; the user take a picture for a scene in the environment by pressing a button, then the system send the picture to the servers in the cloud in order to process it; after it get processed the server return the processing result which receives by the system ,next the system process the given result to produce particular information which finally sent to the user through a headset as a sound[11][12].

Scenario 2:

Smart Eyes system should Warns the user before hitting any object. The system motivates an ultrasonic sensor to rise ultrasonic waves, when this waves hit any obstruction it's reflected back to the sensor, then the system calculates the distance using the taken time of wave from it has been raised until it's reflected bake to the sensor and other constants. If the distance is under 50 cm the system should warns the user[11][12].

3.5.4 Use Case Diagram



Figure(3.2): Use Case

3.5.4.1 Use Case Scenarios

table 3.3 use case scenario for taking a picture.

Name	Take picture
Brief Description	The camera take a picture as a response of Stimulates
Actor	User(Blind)
Pre-Conditions	Check the camera whether is it found
Flow	**Basic Flow:** 1) The blind press a button to take a picture. 2) The system gives a feedback to the blind in a sound format to clearly that the button is get pressed. E1 3) The system sends a machine instruction to the camera to take a picture. 4) The system should store the taken picture in the specified path. Alternative Flow: The system takes a picture dynamically.
Exceptions	If the camera doesn't work the system should send a feedback to the blind.
Post conditions	

Table 3.4 use case description for image processing.

Name	image processing
Brief Description	Process the image by the web system
Actor	Web system
Pre-Conditions	Take a picture.
Flow	**Basic Flow:** 1) The system creates a socket connection. 2) The system changes the image format to binary.

	3) the system transmits the data image over the network to the web system. 4) The web system processes the image and return the result. 5) The system receives the result and store it. 6) The system close connection.
Exceptions	If there is no internet connection the system should tell the user as a feedback.
Post conditions	

Table 3.5 use case description for processing the incoming result.

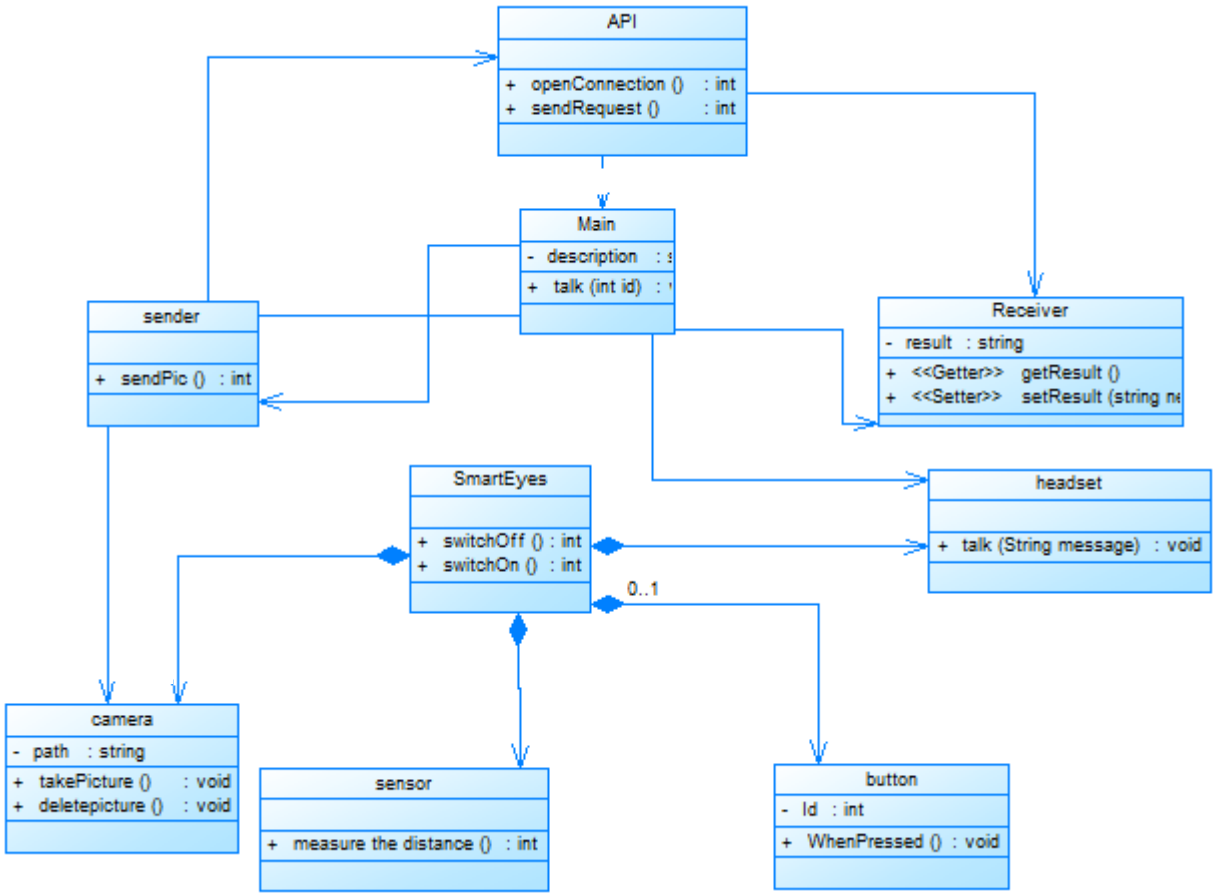
Name	Process result
Brief Description	Process the result of process image
Actor	System
Pre-Conditions	Image processing
Flow	**Basic Flow:** 1) the system converts the result that have been stored in memory into a text format. 2) the system stores the converted result in a variable.
Exceptions	
Post conditions	

Table 3.6 use case description for measure the distance.

Name	Measure the distance
Brief Description	Measure the distance using ultrasonic waves.
Actor	System
Pre-Conditions	Image processing
Flow	**Basic Flow:**

	1) the system switches the sensor on. 2) the sensor produces an ultrasonic wave. 3) This wave will obstruct by any object and reflected back to the sensor. 4) The system measures the distance using the time between the send wave and the received wave. 5) the system sends a warning sound to the user if the distance is less than 50cm.
Exceptions	
Post conditions	

3.5.5 Class Diagram



Figure(3.3): Class Diagram

Chapter 4
Design

4.1 Introduction:

As indicated in the analysis chapter about the importance of the embedded system and the important of the analyses stage too. Design stage (System design) is no less importance of analyze stage. if the analyses stage show and list the functions of the system to the stakeholders in a high level of abstraction using some diagrams such as use case diagram, the design stage come to show and details how these functions can be met by the system and it is providing a clear vision for the developers and programmers. Design stage includes the architecture design, and the system design. Architecture is concerned to represent the structure of the system and give a high level of abstraction view of the system. System design is concerned to show the interaction between the components of the system and the degree of coupling between them. This chapter is organized as following. Section 1 contains the architecture. Section 2 is cover the diagrams that reflect the design of the system and the architecture.

4.2 Architecture design

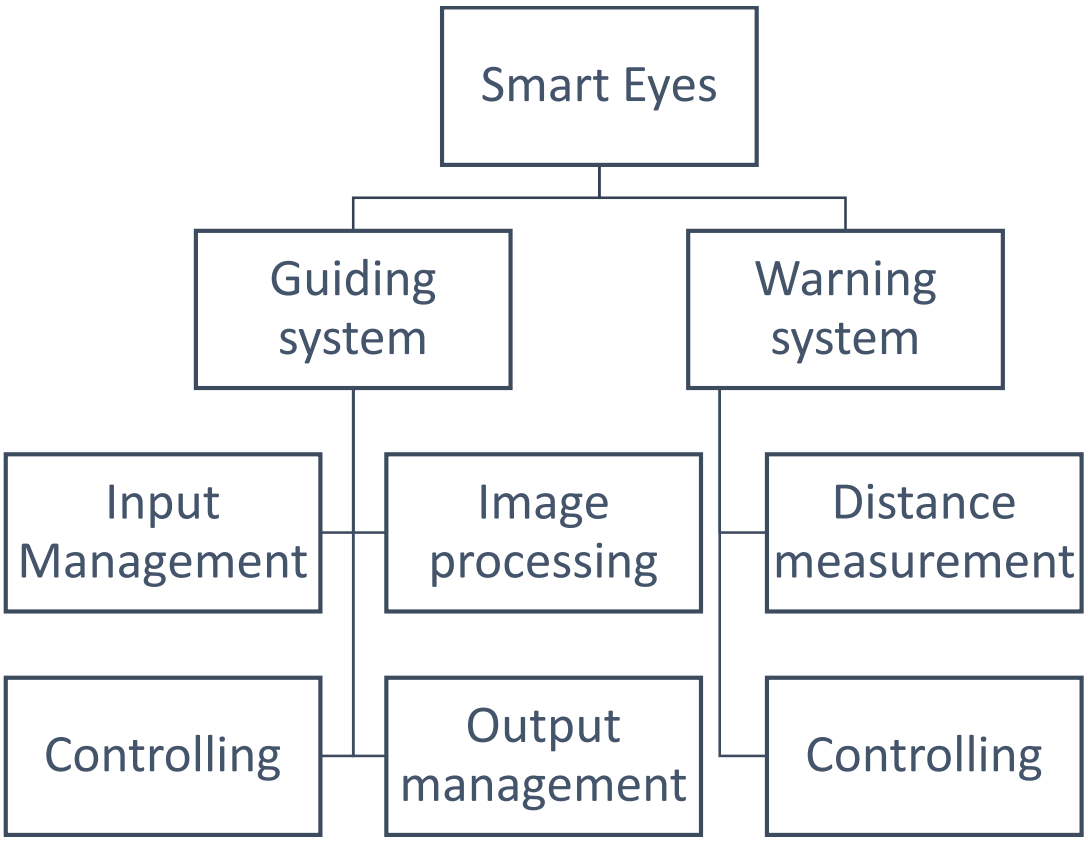


Figure 4.2 Architecture Design

4.3 Diagrams:

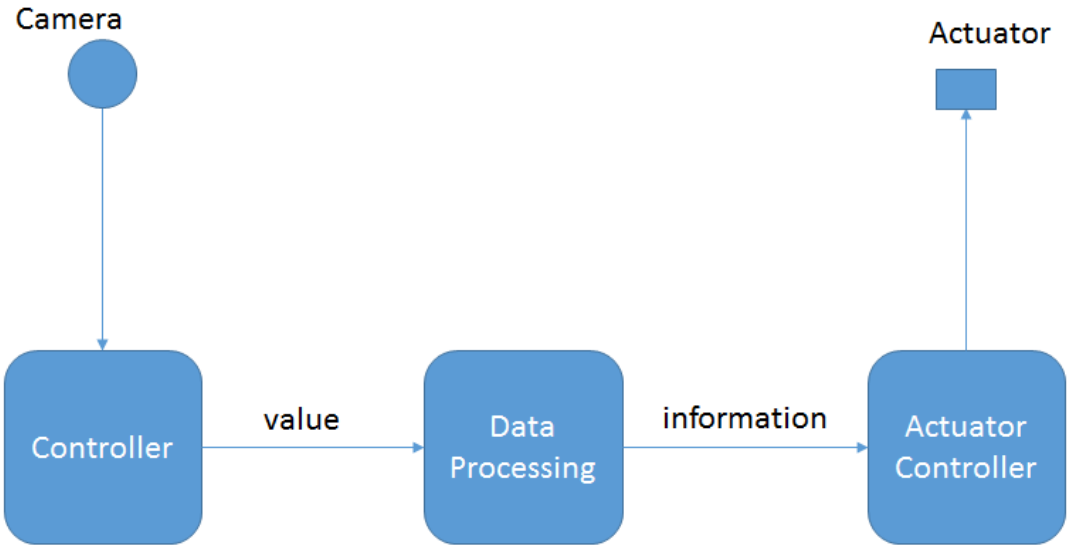


Figure 4.3 : Observe and React of Camera process structure

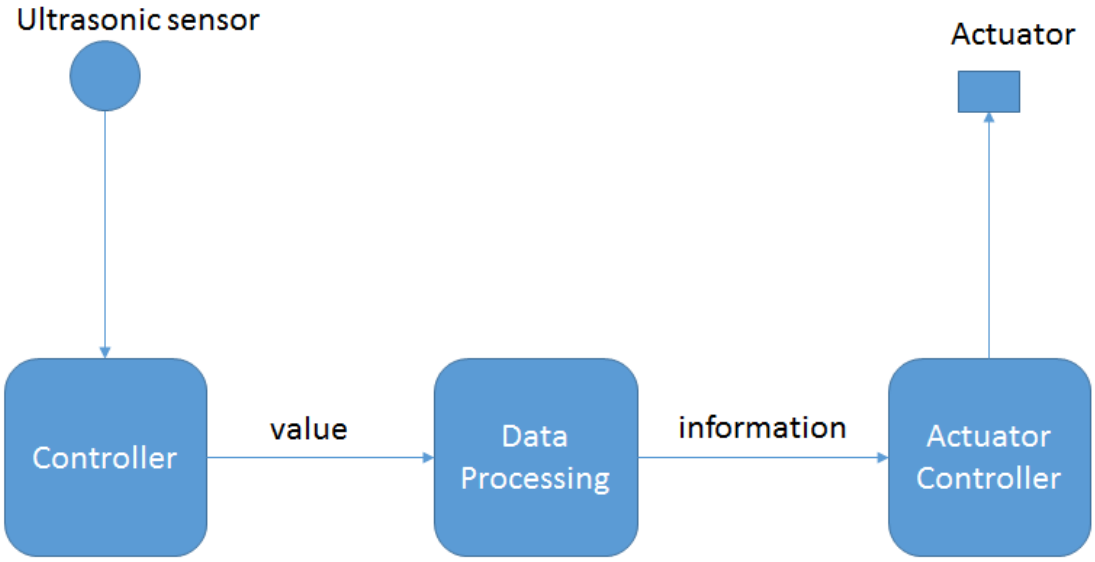


Figure 4.4: Observe and React of Ultrasonic process structure

4.3.1 Class diagram

This diagram shows the system components, also how the system components get controlled.

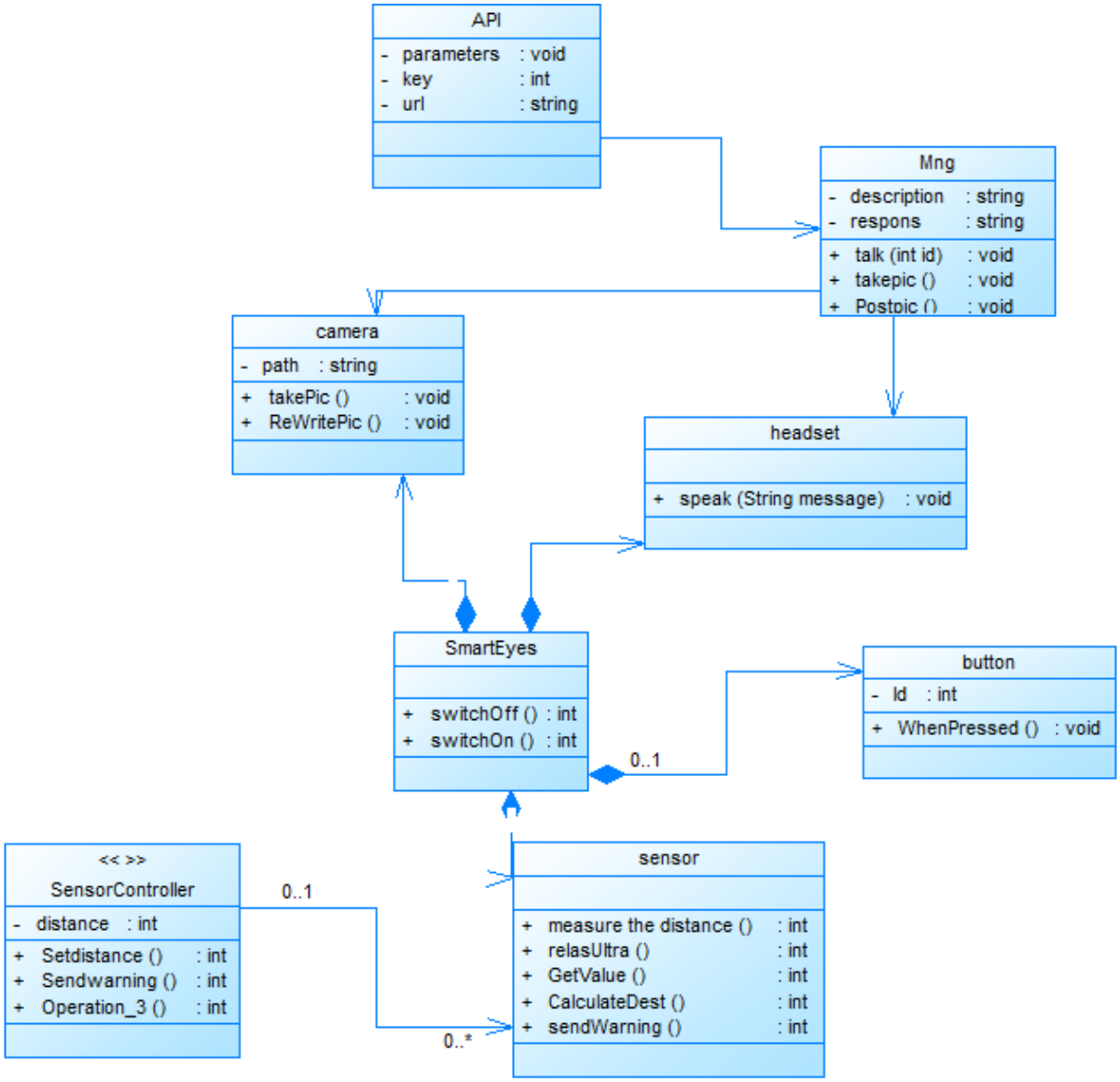


Figure 4.3.1 Class Diagram

4.3.2 The Sequence Diagram:

4.3.2.1 This diagrams show how the sequence of the system operations and how each process get effected by the other.

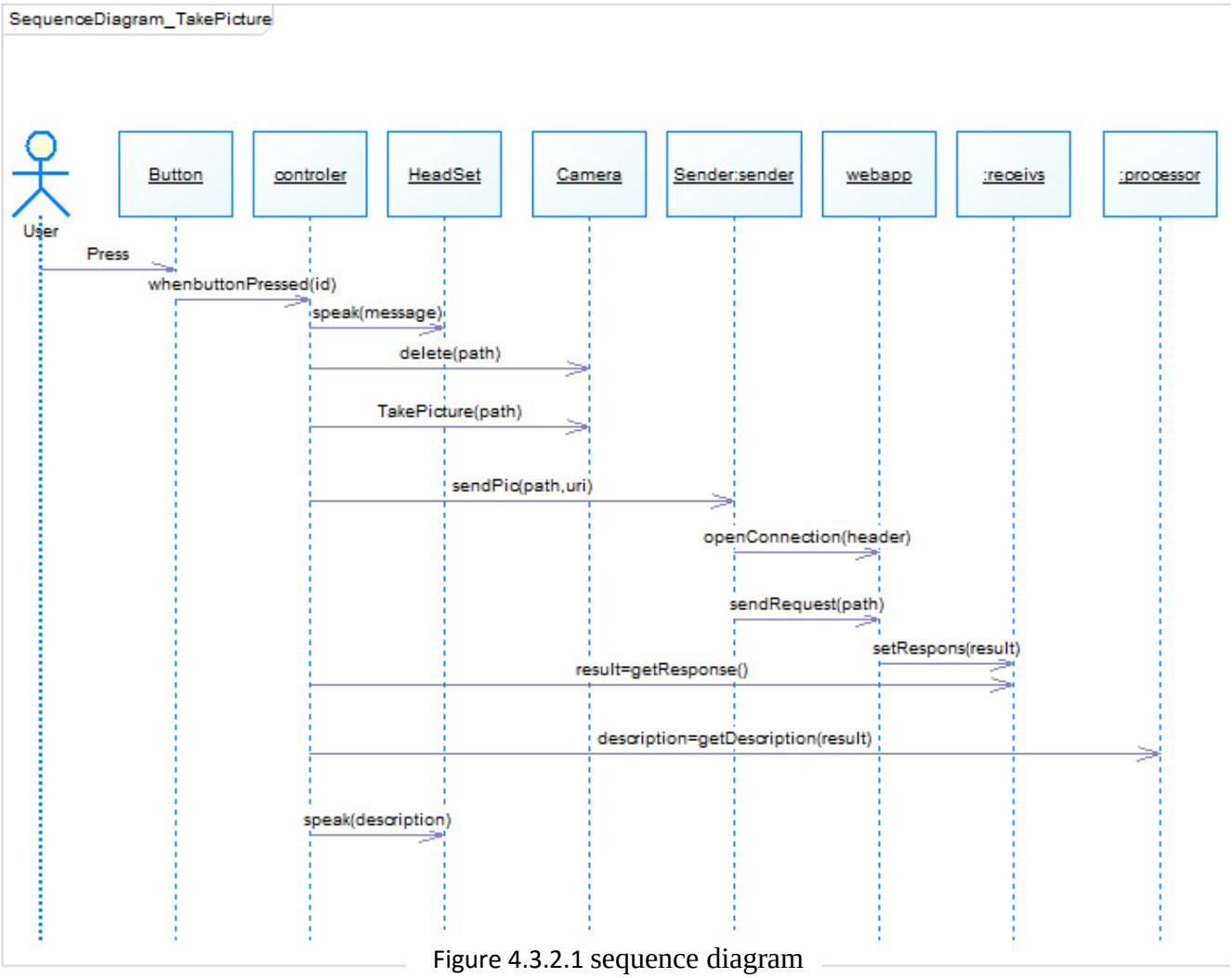


Figure 4.3.2.1 sequence diagram

This sequence diagram shows the Guiding system functions, this diagram shows the operations between the user and the system functions[11][13], when the user start clicking on the tool buttons the user actually run so many operations from tacking the picture to send the result to the headset.

4.3.2.2 Sensor Sequence Diagram:

This sequence diagram shows how the warning system used to produce alarms before the blind hate any obstruction.

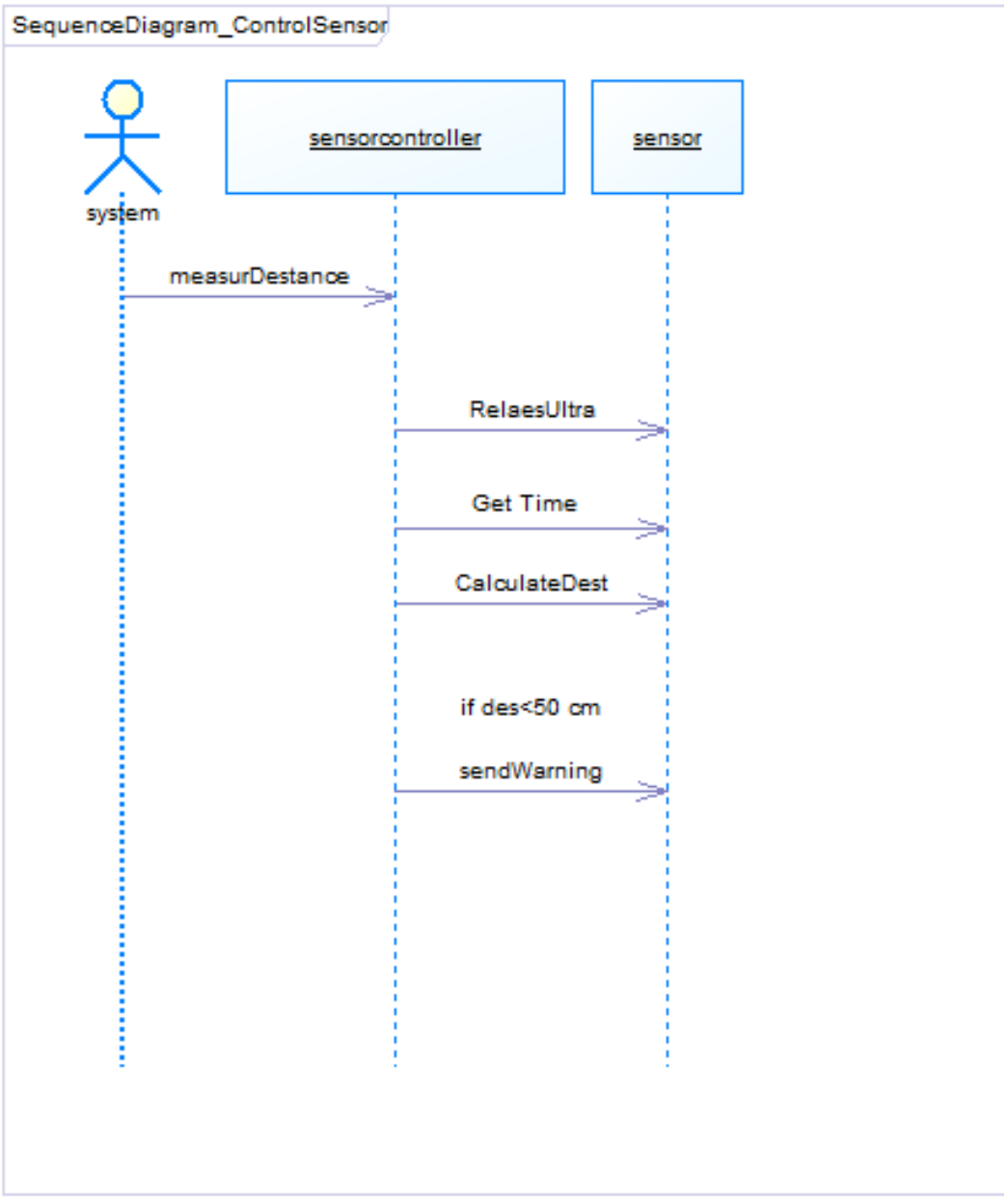


Figure 4.3.2.2 sensor sequence diagram

4.3.3 The State Chart Diagram:

This diagram shows the state of the system processes and the states of the system.

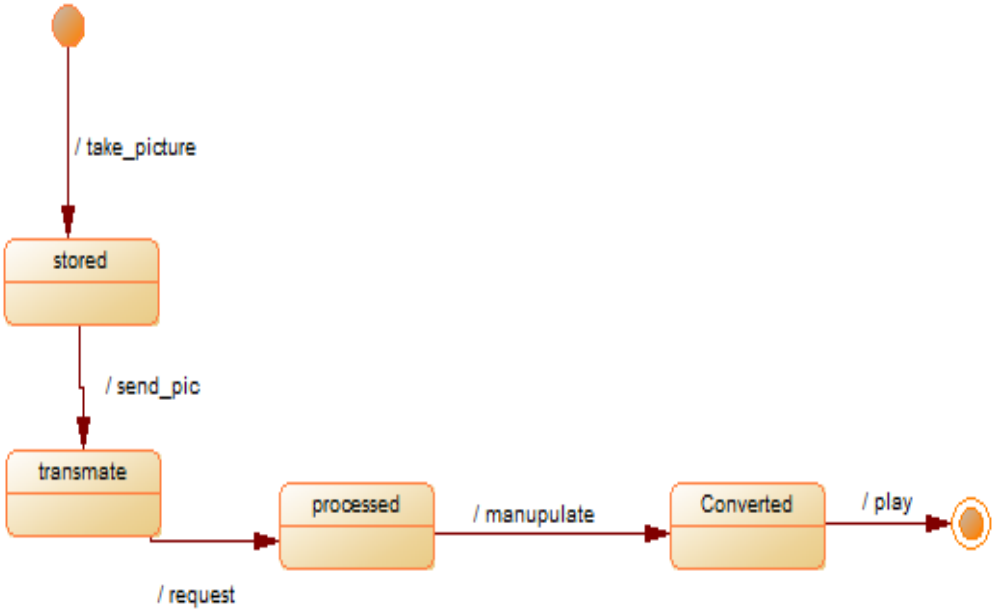


Figure 4.3.3 state chart Diagram

This diagram shows the system states starting from taking the picture till play the result to the blind throw a headset.

Chapter 5
Implementation

5.1 Introduction:

In this chapter we will discuss how these software and hardware components integrated with each other so as to help blinds doing their daily activities, it's shows the system structure, how to implement the interconnection between sub-systems, and it outlines the project stages in real.

5.2 System Implementation Needs:

We used a lot of software and hardware tools in order to implement Smart Eyes, these tools helped us while we have been throw many software development life cycle stages.

5.2.1 hardware tools such as a raspberry pi module 3, ultrasonic sensor, camera pi, some buttons, and a power bank.

1. Raspberry pi, is a series of small single-board computers. It has 40 pins helps to connect to the other devices in order to build a smart system connected with many chips, it also has many specification makes it the best choice for smart systems.
2. Ultrasonic sensor, it's a distance sensor can measure the distance using the time spam between the signal starting and the signal arrive.
3. Camera pi, it's a camera connect to the raspberry pi easily since they have manufactured form the same company.
4. Buttons, they used as an interface between the system user and the system itself.
5. Power bank, we need a power bank to provide this system with power, this power bank can be as much as the user need.

5.2.2 Software tools such as Python 2.7 editor used so as to program the system, Raspbain operating system, cloud services, SDKs and some libraries.

1. Python 2.7, it's a programming language with its editor we used to build this system .
2. Raspbain, it's an operating system we installed it to this chip in order to run and control all of these hardware.
3. Cloud services, it's some APIs used to provide many services such as object description, face detection, and OCR.
4. Libraries, we used some libraries to simplify the hardware dealing.

5.3 Interfaces:

As shown in figure (5.3) these buttons are one click buttons, that's it's do one function per one click, we used it in the cloud services and time to, these kinds of services need just one click from the blind to do their job.

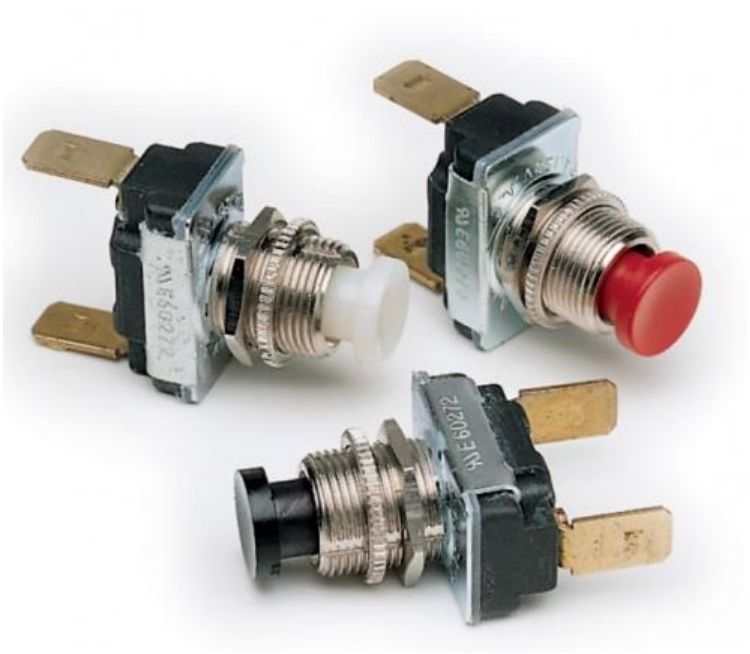


Figure 5.3 : Tool services and time buttons

Figure 5.3.2: Sensor button

As shown in figure (5.3.2) we used an on\off button, this kind of buttons will keep running something for a while, till the user turn it off, it's perfect for the sensor since this sensor used a lot of power to work, we need an on\off button to allow the user to control the ultrasonic sensor, if the

sensor always in the on state it may cause in disturb to the user by warning them every time any place, so sometimes the user need to turn it off [10].

Headset, it's the only way to give the feedback to the user, hearable sounds will give the blinds the information they need.

5.4 Resistors:

We have used some resistors in order to keep the ultrasonic sensor safe, ultrasonic waves consume a huge power so these resistors can protect the sensor from this huge amount of power.

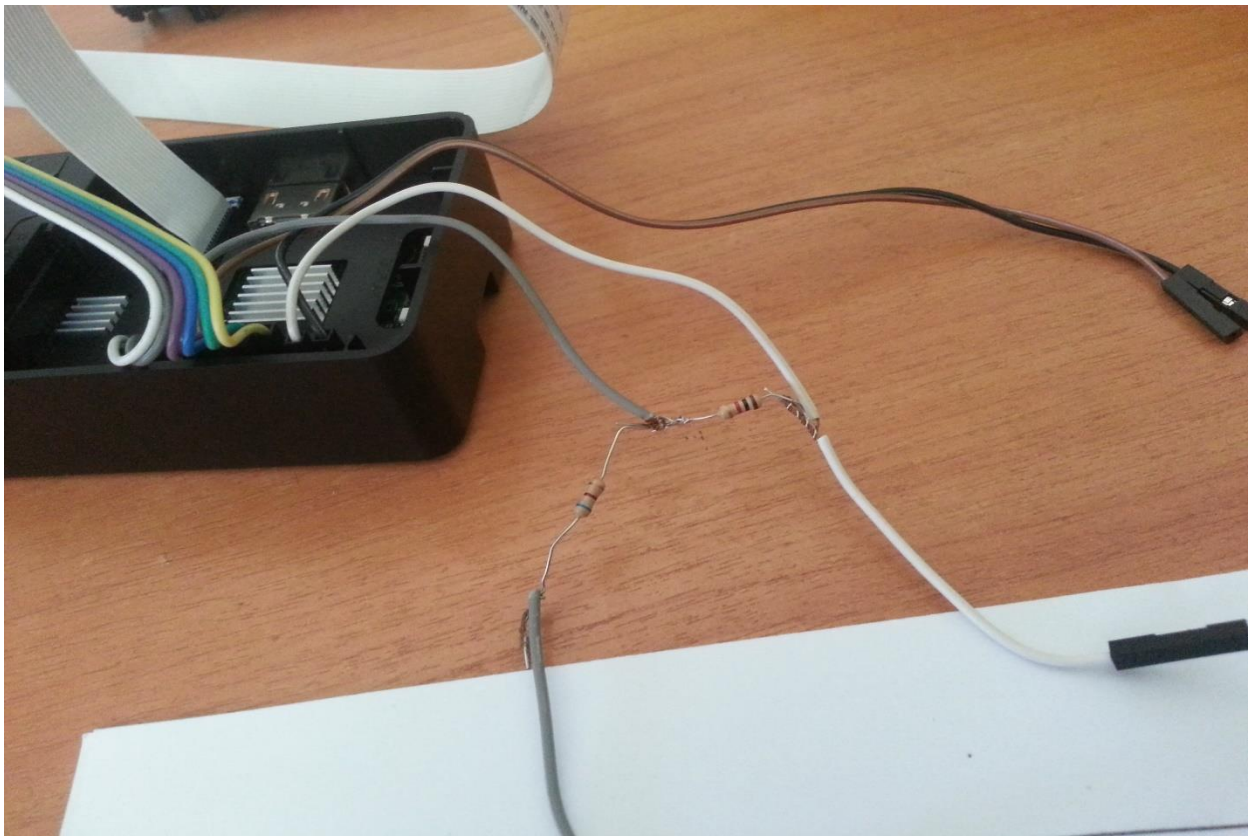


Figure 5.4: sensor's resistors

5.5 Results:

Here we will discuss some of results we got from using the cloud services such as face detection, OSR, and image description.

5.5.1 Face Detection:

Here we will get the number of people in this taken picture also the age, gender and wither who in the picture happy of not through sending the data –image- using the rest technology [14][15].

Figure 5.5.1: face detection's results

Screen shot of the given result:

I see 1 people; 50.3 male looks happy

5.5.2 OCR:

This function will allow the blind to read some text , normal text that have written in a readable way, away for those how can see.

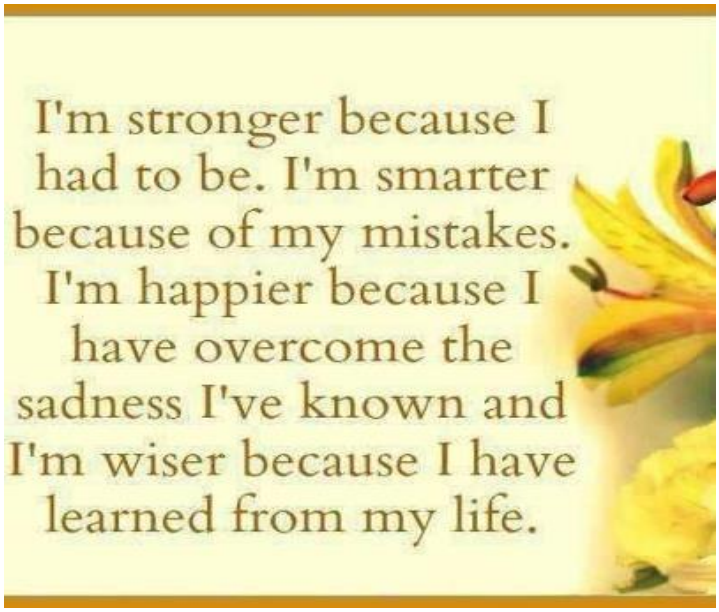


Figure 5.5.2 OCR's results

Screen shot of the given result:

I'm stronger because I had to be. I'm smarter because of my mistakes. I'm happier because I have overcome the sadness I've known and I'm wiser because I have learned from my life.

5.5.3 Description:

This function will allow the blind to get a brief description about the view around him, this description contain the objects in the taken photo.

Figure 5.5.3: Description's result

Screen shot of the given result:

Steve Jobs holding a phone.

5.6 How does this tool work:

This tool designed for those people who can't see, it's a glasses with a high resolution camera on it, this camera can take the pictures of the view around the bind, when the user want to take a picture he/she just click on a button to run any of the tool functions, face detection, image description and OCR to read the text for the blind, distance waring and finally the time, all of these function will return a result telling the blind what is going in front of him, and also answering him about the most common questions he usually ask, this result returned to the blind as a sound he/she can hear it using a headset. The distance sensor will take many measurements of the distance and warn the blind wither he will face anything or not, if the given distance result is lower than 100 cm the system will make a warring sound telling the user that he/she will face an obstacle. The user will get a clear result depends on how clear is the taken picture.

Chapter 6

Conclusions and recommendations

6.1 The conclusion:

This tool tries to help this slice of society in the first place which it is the blind people, it's Provide wearable system using the great harmonic between the hardware and the software components, it's try to use the minimum power to run this system by apply some roles minimize the power usage, it's also helps the blinds to get a full description of the view in front of them, and help the blind to read a written text, and there is an Error ratio of getting the results, this error could happen as the taken photo quality, it also could be because of the new objects that the algorithm couldn't match with the pre-store objects, this error ratio could be between 3 tow 6 years -as an average- in the face detection when the system trying to get the people age, also can be 30% of the objects around the blind when the system trying to get the description of the view in front of the blind. The OCR function is the most accurate algorithm [16], it's transcribe the written letters to a hearable sound using some mathematical roles based on the angels, the error ratio is about 9% of letters in the taken photos. We get these result by testing the system in many places one of them was in the technical museum at the university. Raspbian is the Foundation's official supported Operating System. So it will be identical with the hardware, in windows 10 IoT When you first boot, all you'll see on your Pi is the screen above. You can't control or do anything on the Pi by itself. For that, you'll need to download and install Visual Studio on your Windows PC. Once you do, you can program and control your Raspberry Pi from Visual Studio in Windows 10. This means you can trigger blinking lights, connect to push buttons, control motors, and countless other things, also this operating system and Ubuntu MATE aren't identical and well supported with Raspberry pi as well as the Raspbian.

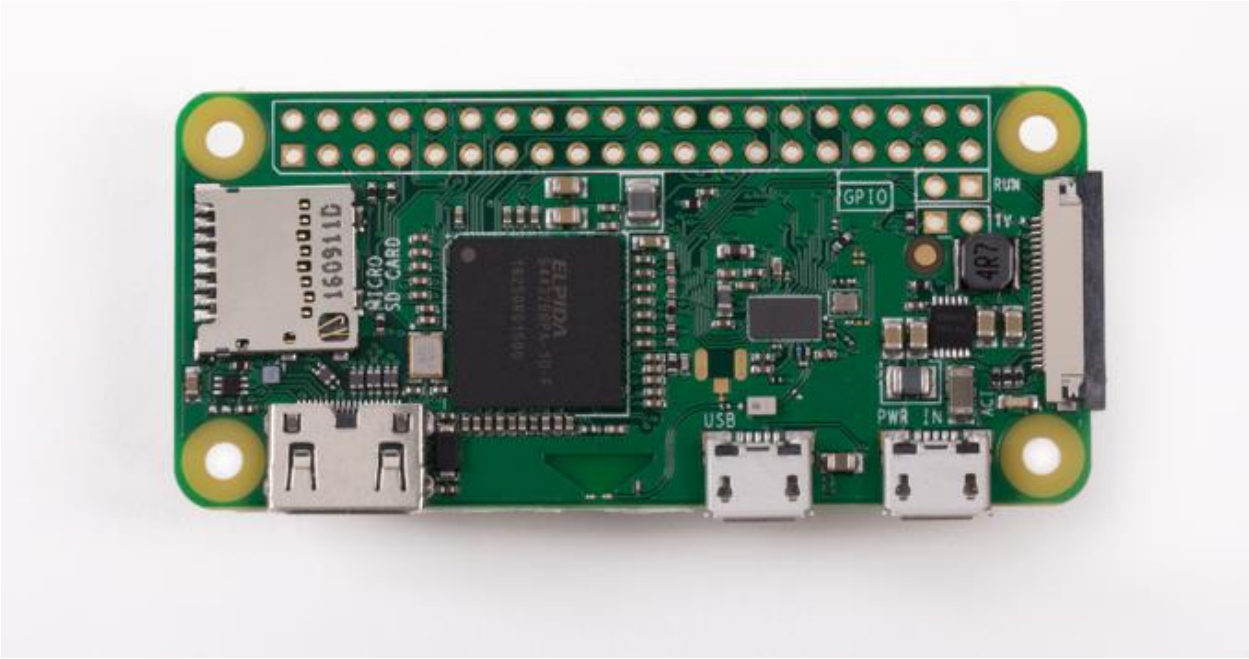
6.2 The Recommendations:

1. There must be a stable internet connection to all this tool functions, some don't need an internet connection.
2. Take a stable photo to provide more accurate description for the taken photo, that's mean take the photo while there is little of no head movement.
3. Don't use this chip with more than this system.
4. Take a full system description about the system and how it works before starting using it.
5. Develop this system by adding a GPS chip to this system to provide a location tracking, it's for discover the blind location if that's needed.

6.3 The Future Work:

This system get developed using a raspberry pi module 3 which it's the most modern available chip, the used software –the system- don't need all of this specification, we used it as a prototype, we were needing a chip can tolerate the testing from a student don't have much experience dealing with electronic chips, so this system can get developed using other chips which they are much smaller in size so the blind can take it on his head as a normal glasses without any additional devices in waist.

We recommended using raspberry pi zero w since it's small in size and needs a small number of Amperes to run, it also the needed specification to run the system.



The Raspberry Pi Zero W extends the Pi Zero family. Launched at the end of February 2017, the Pi Zero W has all the functionality of the original Pi Zero but with added connectivity, consisting of:

1. 802.11 b/g/n wireless LAN
2. Bluetooth 4.1
3. Bluetooth Low Energy (BLE)

Like the Pi Zero, it also has:

1. 1GHz, single-core CPU
2. 512MB RAM
3. Mini HDMI and USB On-The-Go ports
4. Micro USB power
5. HAT-compatible 40-pin header
6. Composite video and reset headers
7. CSI camera connector

Also the system is able to add a GPS chip which It's provide a location tacking sub-system to the system and it's needed when the blind get lost or they need to know where they are.

6.4 Difficulties We Encountered:

- Getting the electronic chips was the main problem especially in the situation of our homeland, we got them online but the problem was how to bring them to Yemen.
- Working on this chip needs a special condition.
- Very few resources.

References

[1] [http://www.arduino.org/learning/getting-started/what-is-arduino] Arduino website last update 2017.

[2] [http://www.banana-pi.org/m2u.html] Banana pi website last update 2017.

[3] [https://www.raspberrypi.org/blog/raspberry-pi-3-on-sale/] Raspberry pi website the sale department.

[4] The Official Raspberry Pi Projects Book from The Makers of the Official Raspberry Pi Magazine Part 3.

[5] [www.raspberrypi.org] Raspberry pi website last update 2017.

[6] [https://azure.microsoft.com/en-us/overview/what-is-cloud-computing/]

[7] [https://www.raspberrypi.org/products/camera-module-v2/] Camera module version 2.

[8] [https://www.dexterindustries.com/gopigo/] GoPiGo website last update 2017.

[9] Ian, Sommerville. software engineering, 9th edition chapter 3,4,5 and 6. University of St Andrews. 2011

[10] Warren, Gay. Raspberry Pi System Software Reference, 2nd edition. Apress. 2014.

[11] Behrouz A.Forouzan. Data Communications and Networking. 4th edition Pp.56-120. Alan R. Apt. 2007.

[12] Andrew S. Tanenbaum and Maarten Van Steen. Distributed Systems Principles and Paradigms.2nd Edition. Pp.105-169.

[13] Elloiotte Rusty Harold. Java networking programming. 4th edition. Pp.117-165. O’ Reilly Media. Oct 2013.

[14] Subbu Allamaraju. RESTful web services Cookbook. O'Reilly Media. 2010.

[15] Savas Parastatidis, Jum Wiber. REST in Practice: Hypermedia and Systems Architecture. O'Reilly Media. 2010.

[16] Arshdeep Bahga. Cloud Computing: A Hands-On Approach. 2013.