T.C.
DOKUZ EYLÜL UNIVERSITY
ENGINEERING FACULTY
ELECTRICAL & ELECTRONICS ENGINEERING
DEPARTMENT

DEVELOPING SAFETY SYSTEMS AT TRAIN STATIONS ESPECIALLY FOR PEOPLE WITH DISABILITIES

Final Year Project

by

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İZMİR

PROJECT EVALUATION FORM

We certify that we have read this thesis and that in our opinion it is fully adequate, in scope and qualify as an undergraduate thesis, based on the result of the oral examination taken place on __/__/_____

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ABSTRACT

In today's technology, image processing is developing rapidly and finding solutions to many problems, for example, in the medical field (disease diagnosis, fracture detection, nodule detection, vascular identification), security (face / fingerprint recognition, motion detection).

This project aims to improve safety at train stations. The high voltage in the rail system and the rapid arrival of the train are lethal because of people's carelessness and wrong actions. The priority of this project was hearing and visually impaired people. The distance sensor was helped them indirectly. When there are people who violate the warning line in the station, the red LEDs buried beneath the line of warning will give a warning by means of a fixed camera. The train is about to get in the station and it was been easier to realize that it is approaching that thanks to the red, yellow and green LEDs. The speaker at the bottom of this traffic light was been able to analyze the approach of the train more comfortably for the visually impaired people.

This project was done with human tracking and video image processing using OpenCV library and Python as interface. Data was been sent from the central computer to the microprocessor by serial communication when people using the rail system over the video received from the camera violate the warning line. The information was also been used by the ultrasonic sensor to be sent to the microprocessor related to the distance of the train. When the specified conditions was formed according to the program to be written, necessary warning was been given to the passengers with both sound warning and light warning.

Keywords

Real-time image processing systems, Histograms of Oriented Gradient (HOG) detector, distance detection, control systems

ÖZET

Günümüz teknolojisinde görüntü işleme hızlıca gelişmekte ve birçok soruna çözüm bulmaktadır. Örneğin, tıp alanında (hastalık teşhisi, kırık belirleme, nodül tespiti, damar belirleme), güvenlik alanında (yüz/parmakizi tanıma, hareket tespiti) gibi.

Bu proje ile tren istasyonlarındaki güvenliğin geliştirilmesi amaçlanmıştır. Ray sistemindeki yüksek gerilim ve trenin hızlı gelmesi, insanların dikkatsizliği ve yanlış hareketlerinden dolayı öldürücü olabiliyor. Bu projeyi düşünürken öncelik işitme ve görme engelli insanlardı. Bu konuda onlara ya da insanlara dolaylı yoldan mesafe sensörü yardımcı oldu. İstasyondaki uyarı çizgisini ihlal eden biri ya da birileri olduğunda sabit bir kamera sayesinde ihlal çizgisinin altına gömülü kırmızı ledler uyarı verdi. İşitme engelliler için trafik lambalarına benzer lamba ile kırmızı, sarı ve yeşil renkler sayesinde trenin istasyona girmek üzere olduğunu ve girdiğini idrak edilmesi kolaylaştı. Görme engelli insanlar ise bu trafik lambasının altındaki hopörlör sayesinde trenin yaklaştığını daha rahat analiz edebildiler ve konumlarını aldılar.

Bu proje OpenCV kütüphanesi ve arayüz olarak Python kullanılarak insan takibi ve video görüntü işleme ile yapıldı. Kameradan alınan video üzerinden raylı sistemi kullanacak olan kişiler uyarı çizgisini ihlal ettiği zaman merkezi bilgisayardan mikroişlemciye seri haberleşme ile veri gönderildi. Ayrıca kullanılan, ultrasonic sensör tarafından da trenin mesafesi ile ilgili mikroişlemciye bilgi gönderildi. Yazılacak programa göre belirtilen şartlar oluştuğunda hem ses uyarısı hem de ışıklı uyarı ile yolculara gerekli bilgilendirme yapıldı ve estetik bir hava katıldı.

Anahtar Kelimeler

Gerçek zamanlı görüntü işleme sistemleri, Yönlendirilmiş Gradyan Histogramları dedektörü, mesafe algılama, kontrol sistemleri

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1. INTRODUCTION

1.1 Aim of Project

Nowadays, train accidents often result from the collision of trains, derailment, or poor ground under the rail. Sometimes, because of the carelessness of the pedestrians and passengers, they can fall into a high-tension rail due to a violation of the rules and result in injury or death. Although these events do not happen very much, the importance should be given thanks to technology. In addition, people are not helped or cared as much as necessary for hearing and visually impaired people .

Many measures have been taken for pedestrian safety but not enough. One of the problems experienced at train stations or stations today is a yellow line violation. Many studies have been done on these problems, but they have not been successful enough. For example; security personnel increased but the result has not changed much. But it can both solve and aesthetics with image processing and distance sensors. As a result, image processing and distance sensor systems have an important place in many applications in the real world.

1.2 Overwiev

It is the field of artificial intelligence and image processing that tries to understand and imitate the human vision system. One of the important topics in computer science is image processing [1]. Image processing techniques are utilized when a useful information has to be interpreted and interpreted from an image. The image to be processed can be obtained with the help of cameras, optical scanners and cameras. By digitizing these digital images, different processes can be performed to produce meaningful interpretable results.

Distance sensors are very important elements for technology. Because it can make systems that perceive how close it is to various obstacles and objects. The function of the sensor in this project will alert you with sound and light when the train is approaching a distance. There are two kinds of sensors when it comes to sensor. Infrared and ultrasonic.

Infrared sensors have a narrow detection range. In other words, they can detect objects in a confined space without interfering with other objects. If the object to be detected is too thin or there are holes on it, the sensor beam can pass through the object and measure the wrong values.

Ultrasonic sensors use high-frequency sounds that people cannot hear to detect distance. The ultrasonic sensors send a short sound wave and wait for it to come back. They measure the time between sending and receiving the sound. The elapsed distance is also measured by the sensor. The distance is calculated according to these data. Ultrasonic sensors are useful in applications that require a large detection area. If more than one object is detected in the detection area, it may cause interference [2]. The sensor detects the close object. Importantly, the ultrasonic sensors are not affected by the parameters other than the shape and distance, while the infrared sensors depend on the color of the object to be detected.

1.3 Image Processing At Train Stations In Literature

There was not much work on image processing in railway stations. But there is a nice example project. It is similar to the work of the project, has been used with the smart camera with two video analysis capabilities at this project in Turkey in in 2010 [3]. The project was examined and discussed whether it could inspire any part of the project. In addition, seeing the existence of such projects shows the value given to human life. It is aimed to prevent accidents in level crossings with this project. With the system to be installed, smart camera with two video analyzing capabilities to see level crossings, level gates, and projectors / projectors for illumination of the level crossing when light is inadequate.

Detection and imaging cameras installed in the gate have the ability to transfer images over 3G to a remote point with an Internet connection. In case of any level of entry into the level crossing, which affects the course of the train, the cameras automatically generate alarms. In the case of a train approaching 1.5 km (or any other desired distance) at the level crossing through the display screen placed on the trains, the real-time display of the relevant level crossing and the alarm information are transmitted on the screen on the train [3]. This allows the engineer to be aware of a dangerous situation and adjust the speed of the train. Improved event detection system; a wide-spectrum camera, lens and high processing power consists of an image processing card.

All components are protected by an IP65 standard enclosure, allowing the camera to operate continuously in all weather conditions [3]. The event detection and image transmission camera uses the latest image processing techniques, resulting in 1/10,000 errors. However, in order to reduce the error rate of the system, the total error rate was further reduced by using two event detection and imaging cameras. The camera image and alarm information can be accessed from a remote point with internet connection via internet browsers. The event detection and image transmission camera is one of the main components of HEGEUS, which contributes to the performance of HEGEUS with high accuracy. The event can perceived more clearly in Figure 1.1 [3].

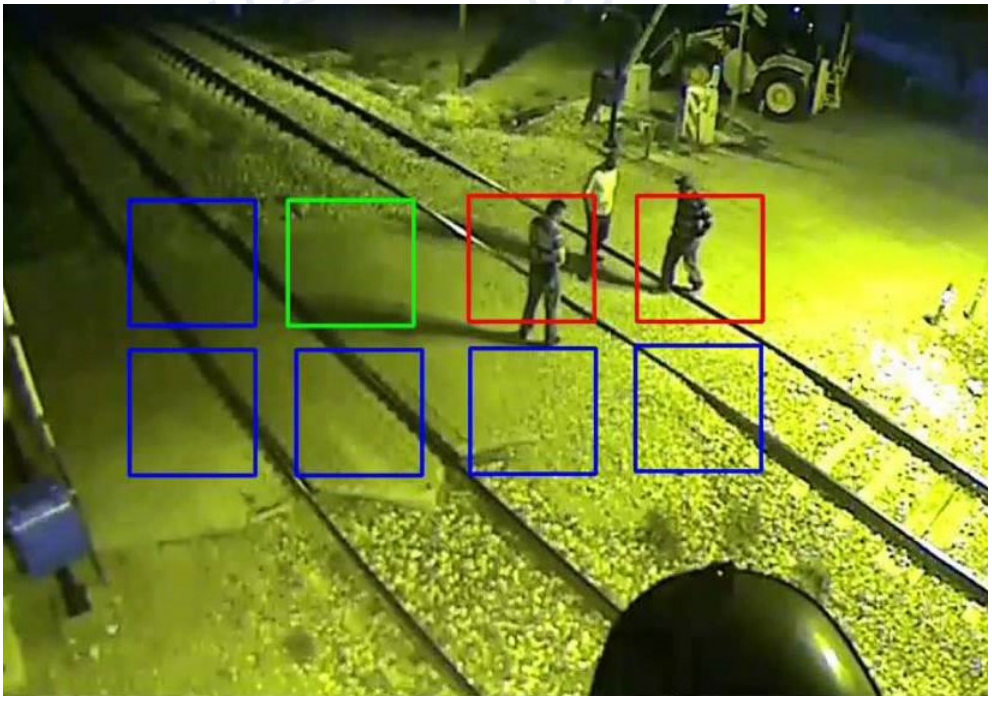

Figure 1.1: Event Detection and Image Transmission Camera [3]

In 2007, another project related to this subject is as follows: Recently, to prevent and monitor the safety accident in railway platform, CCTV(Closed Circuit TV) is widely used. Currently, CCTV is installed at busy areas for monitoring and controlling passenger's situation from CCR(Central Control Room) or local station. However, CCTV is a passive system which provides limited capability to maintain safety about boarding platform[4].

The aim of this project is a platform for surveillance monitoring system that uses image processing technology to propose at the train station for passenger safety. The proposed system monitors almost the entire line length in the platform using multiple cameras, as shown in Figure 1.2. Each camera occupies a 20-foot trail area and uses the image processing technology to detect in real time whether the human or dangerous obstacle is in the predetermined monitoring area. When an emergency is detected, the system immediately gives both the train driver, the CCR, and the station staff both video information and an alarm message [4].

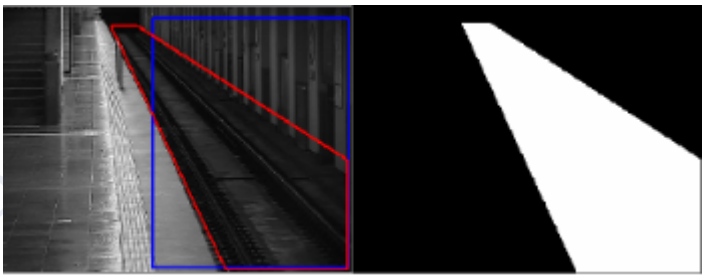

Figure 1.2: Train Area and Dangerous Area [4]

2. BACKGROUND INFORMATION

2.1 Image Processing

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too [4].

This part deals with the formation, acquisition and processing of images. Its contents can be best represented as a diagram where the evolution of the considered information (images) and the processes involved are shown in the Figure 2.1.

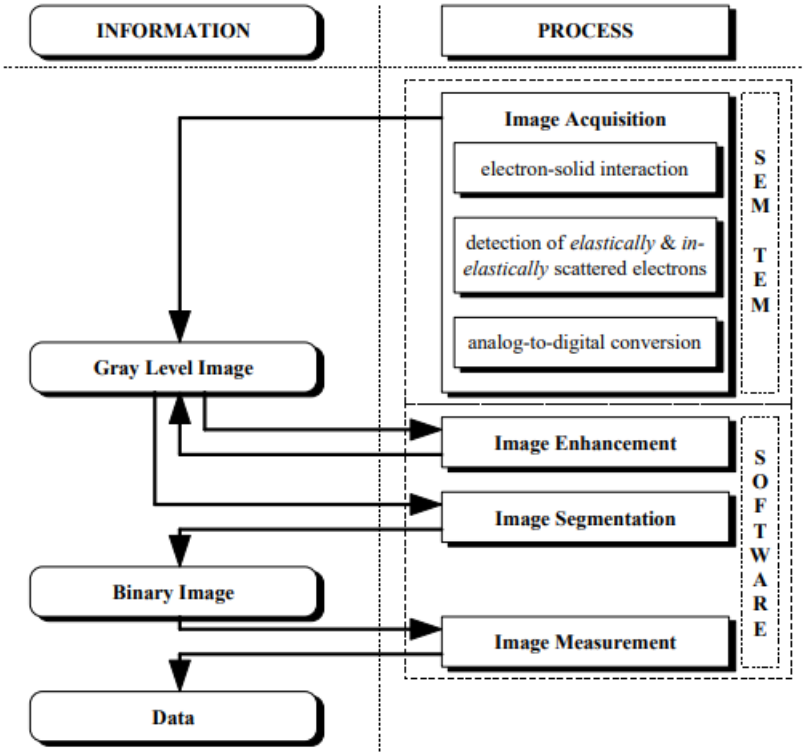

Figure 2.1: The Evolution of the Considered Information and the Processes [4]

2.1.1 Purpose of Image Processing

The purpose of image processing is divided into 5 groups. Them:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image.
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern – Measures various objects in an image.
5. Image Recognition – Distinguish the objects in an image.

2.1.2 Types of Methods Used For Image Processing

The two types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to image processing [5]. Digital Processing techniques help to manipulate digital images using computers. The raw data from the display sensors on the satellite platform contain deficiencies. To overcome such defects and to achieve the specificity of knowledge, it has to go through various stages [5]. Three general stages that all data types must pass through when using digital technique are Pre-processing, development and imaging, information extraction.

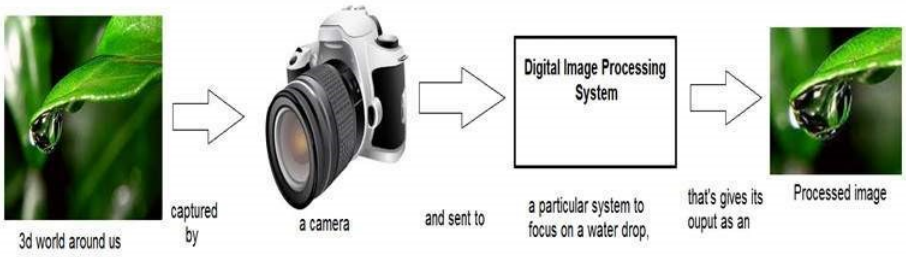

Figure 2.2: Analysis of How It Works [5]

An image has been captured by a camera and has been sent to a digital system to remove all the other details, and just focus on the water drop by zooming it in such a way that the quality of the image remains the same in the above Figure 2.2.

2.2 Distance Sensors

Distance sensors are used to measure distance. They give the distance from the sensor to the electrical outlet. The sensors vary according to the application and working environments. It is possible to find sensors in many brands and properties in the market. Distance measurement is widely used in industrial systems for process and quality control purposes. In scientific studies, distance measurement in robotic applications may be required at different sensitivity levels. In order to maintain the safety distance on vehicles, systems that automatically reduce the speed by using distance measurement are being used. In order to get more efficient results, it is necessary to examine the working principles of Ultrasonic and Infrared sensors used in distance measurement [7].

Infrared (IR) sensors are widely used for distance measurement. It is cheaper and faster than ultrasonic sensors. However, IR sensors have non-linear characteristics. The reflection, scattering and absorbing properties of the surface must be known in advance as they react differently to the properties of the object surfaces[8]. The rapid response of IR sensors has been instrumental in the development of robot applications. Some IR sensors are based on phase shift measurement and provide a measuring range of 5cm-10m, but are quite expensive [9].

Similarly, ultrasonic (US) sensors are also widely used for distance measurement. Reliable in obstacle detection. Detection can be used in poor light and transparent objects because it is not dependent on vision. However, US sensors have some limitations depending on the high beam width and reflective surfaces. It cannot detect objects close to 0.5m. The sensor detects more accurately the objects that form an approximately vertical reflection to the acoustic axis. It has 1 cm sensitivity in distance measurements up to 6 m. Among the measurement methods used, US flight time is the most accurate result and is defined as the time between the sending of ultrasonic pulses at the sound speed and the sufficient amount of US traction train. The shots reflected from the body have a speed of about 340 m/s. The response time is high for individual measurements [10]. For example; detection of an object at a distance of 6 m takes 35 ms.

2.2.1 Infrared Sensors

The other type of sensor used to measure the distance of an object is infrared sensors using the infrared wavelength from the group of optical sensors. The narrow beam is emitted by the IR LED via the lens. The light reflected from the object is received by the position sensor (PSD: Position Sensible Photo Detector) via a second lens. The conductivity of the photo sensor depends on the position of the light. A voltage is generated depending on the conductivity. The distance according to this voltage value is calculated [9].This situation can be better understood in Figure 2.3.

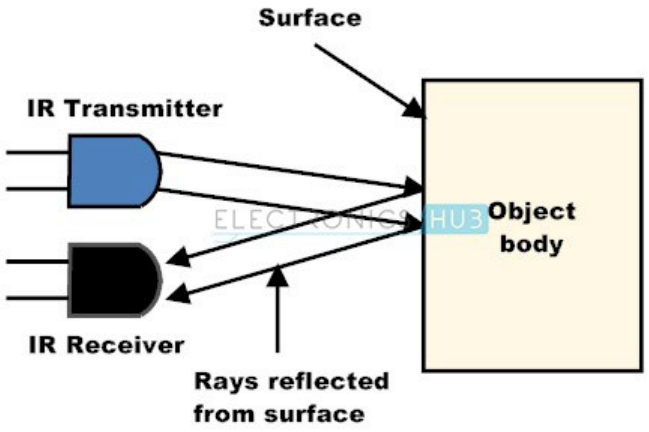

Figure 2.3: Reflected and Sent Light Beams in Infrared Sensor [9]

The output of the IR sensors is inversely proportional to the distance. In other words, the output voltage decreases as the distance increases. Since the measuring range of each sensor is different, distance-voltage graphs are given separately for each sensor in the catalogs. The maximum distance that can be measured is restricted in two ways: The intensity of the reflected light decreases and the smallest position changes due to the distance cannot be detected by the PSD [9]. If a very distant object is outside the measurement limit, its distance will be shown as the highest value. The closest distance to be measured depends on the characteristics of the sensor. The circuit of infrared sensor is shown in Figure 2.4.

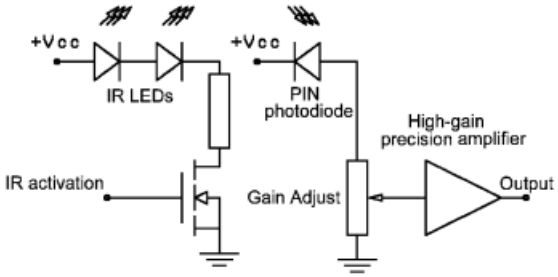

Figure 2.4: Equivalent Diagram in Infrared Sensor [9]

2.2.2 Ultrasonic Sensors

Ultrasonic sensors send sound waves to detect targets. The piezoelectric transducer sends briefly intense sound pulses through. The distance from the target is determined by the time taken with the shot [10]. Due to their reliable performance, the ultrasonic sensor can be used in problematic environments where precise measurements are required and reflections are high. It is not affected by the color of the object, its transparency, ambient noise, dusty atmospheric conditions. It provides contactless distance measurement. Has a wide detection range[10]. Particularly in materials with high reflectivity, for example; is used effectively in solids, liquids and granular materials.

The ultrasonic sensors send a short sound wave and wait for it to come back. They measure the time between sending and receiving the sound. The elapsed distance is also measured by the sensor. The distance is calculated according to these data.It is shown how it is calculated in Figure 2.5.

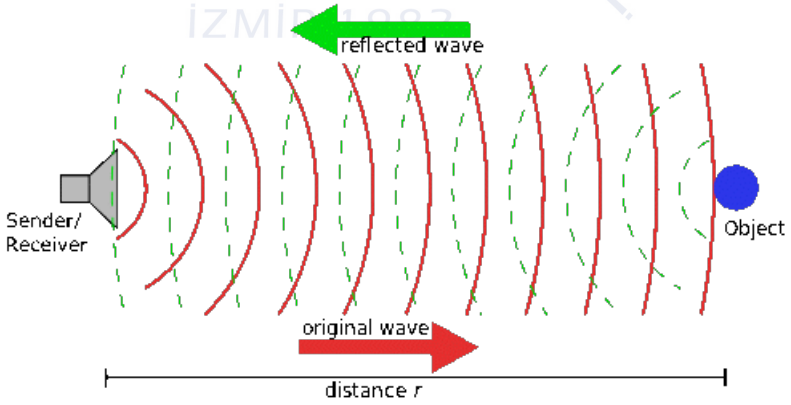

Figure 2.5: Working Principle of Ultrasonic Sensors [10]

The ultrasonic circuit is adjusted in such a way as to stay in balance as long the same as the output frequency of the transmitter. If there is some movement in the area covered by the ultrasonic emission the signal that is reflected back to the receiver becomes distorted and the circuit is thrown out of balance. The circuit works from 9-12 VDC and can be used with batteries or a power supply in Figure 2.6.

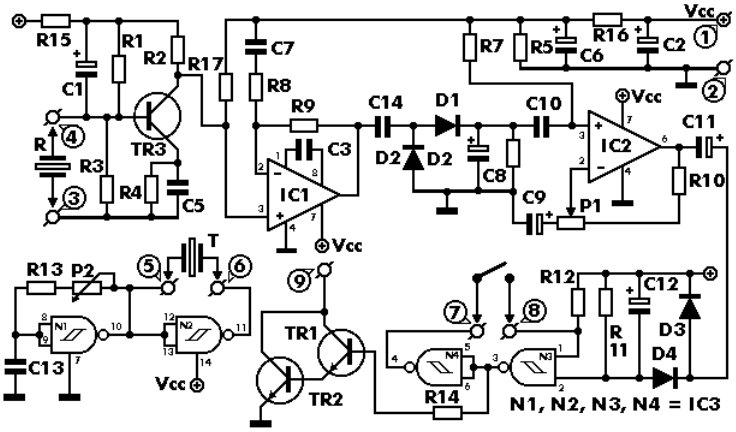

Figure 2.6: Equivalent Diagram of ultrasonic sensor [10]

3. ALGORITHM

3.1 Real Time Pedestrian Dedection In Image Processing

Pedestrian recognition is one of the most challenging problems in the field of computer vision. There have been many recognition algorithms proposed for purposes such as the prevention of traffic accidents using vehicle cameras [11]. However, a recognition algorithm is required in a limited-resource environment that not only provides high accuracy but also real-time processing for embedded systems. Pedestrian detection is an important and important task in any intelligent video surveillance system, as it provides basic information for the semantic understanding of video images.

Pedestrian detection video tracking, contact behavior analysis, driver support system for smart cars can be used in different applications. The techniques of machine learning are widely used in the detection of pedestrians. When classifying people in the image, it is very important that a selective/distinguishing feature from the object to be found is found as much as finding a suitable classifier [12].HOG (Histograms of Oriented Gradient) has been shown to be successful in the identification of pedestrians.

3.1.1 Histograms of Oriented Gradient (HOG)

HOG is not only used for recognition of different objects but also for feature extraction. Implemented in OpenCV. HOG is a technology that shaped the last period. In crowded environments, human tracking or security systems have been extremely important. In this project, we try to recognize the people on the image by using HOG [13]. As you can imagine here, a window is circulated on the image. You will need to search these windows. Because the objective is to find the people and get into a rectangle.

Considering how the image is navigated over the window, what people are and how they are recognized. So there is a tree in the window, the signage, the car or the human? This is the question that is sought. Here HOG is preferred because it gives good results. Of course, a recognition process is required to do, in fact, a machine learning technique must be applied. In other words, a group of labeled data with HOG

feature extraction, given to a selected classifier, we need to train this classifier. In a new input given later, the classifier responds according to the learning capacity [14].

An overview of the feature extraction and object detection chain. The detector window is tiled with a grid of overlapping blocks in which Histogram of Oriented Gradient feature vectors are extracted. The combined vectors are fed to a linear SVM for classification [15]. It is shown in Figure 3.1.

Figure 3.1: Overview of HOG's Operating Principle [15]

3.1.2 HOG Interaction With OpenCV

OpenCV is used to check the functionality of HOG as a pedestrian detector from a higher level. This means that the details of the algorithm are abstract here because HOG is one of the built-in functions provided by OpenCV. This function provided a strong starting point for software simulation in that it showed us the capabilities i.e. detecting pedestrians and limitations i.e. speed and accuracy, of HOG in software. This program detects pedestrians in an image or a series of images using the class.

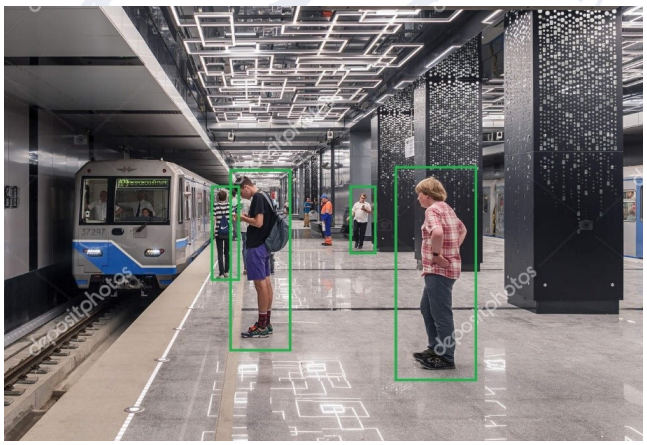

Figure 3.2: Example of the OpenCV HOG Algorithm Using the Built-in Webcam [15]

HOG descriptor which contains all of the functions associated with the HOG algorithm. A simple combination of these two functions, video streaming with people detection and it is evident that the HOG algorithm is successfully detecting people from a webcam in Figure 3.2 and Figure 3.3.

Figure 3.3: Alternative Example of the OpenCV HOG Algorithm Using the Built-in Webcam

4. SOFTWARE DESCRIPTION OF THE PROJECT

4.1 Python

Python is a programming language (such as C, C ++, Perl, Ruby, and so on). It allows you to dominate the black box standing in front of you, the computer. This programming language was developed by a Dutch programmer named Guido Van Rossum at the beginning of the 90s . Most people think that this programming language is taken from the python snake by being called Python. However, the name of this programming language does not come from the python snake. Guido Van Rossum named this programming language inspired by a show by Monty Python koms Flying Circus, a British comedy group called The Monty Python [16]. But even so, it is almost a tradition that the Python programming language is represented in many places by a snake figure. Python is a programming language. Moreover, it is an easy to learn programming language in many language.

They can be run without compiling one of the great features of Python programs is that, unlike languages such as C and C ++ . Since, the compilation process is eliminated in Python, the program can be developed very quickly with this language . In addition, the simple and clean syntax of the Python programming language has made it a preferred language by many programmers. Python's syntax is clean and simple, so it's easy to write programs and read a program written by someone else, compared to other languages. Thanks to Python's above features, large organizations worldwide (such as Google, YouTube and Yahoo!) need Python programmers at all times [16]. The Python programming language and those who know this language are not only interested in international companies. Python institutions and organizations in Turkey have recently started to attract the attention. This language is slowly finding its place in the curriculum of universities in Turkey. In essence, you may want to learn the Python programming language, not for another programming language, for many different reasons.

4.2 OpenCV

OpenCV (Open Source Computer Vision) is an open source image processing library. It was started to be developed by Intel in 1999. Later, the process of development continues with the support of companies such as Itseez, Willow, Nvidia, AMD and Google. The first release, OpenCV alfa, was released in 2000. Initially, C programming language was developed and many algorithms were developed with C ++ language. Open source is an open source library and is under development with BSD license. BSD license means that you can use this library free of charge in any project. The OpenCV platform is an independent library so it can run on Windows, Linux, FreeBSD, Android, Mac OS and iOS platforms. C ++, C, Python, Java, Matlab, and EmguCV library through Visual Basic. C and Visual C ++ languages developed by communities through different wrappers Perl and Ruby programming languages easily with OpenCV applications can be developed [17].

The OpenCV library has more than 2500 algorithms for image processing and machine learning. With these algorithms, facial recognition, distinguishing objects, detecting human movements, object classification, plate recognition, processing on three-dimensional images, image comparison, optical character identification OCR (Optical Character Recognition) can be done easily [17].

4.3 Flowchart

In order to solve a problem, it is called algorithm to write process steps step by step in a clear and easy to understand manner. The algorithm should always work correctly and should be terminated as soon as possible. Multiple algorithms can be generated for a problem, but the important thing is that it should give the right result and be able to answer any question about the problem. An algorithm must have input, processing, and output sections.

The problem have been determined once the processes for solving , the schema created by using certain geometric shapes in the order of operations is called flow chart. If the flowchart provides all the steps clearly and correctly, the program can be encoded on the computer. This is a very important solution for software.

4.3.1 Algorithm of Block Diagram of Image Processing

It is shown flowchart showing different phases in digital image processing in Figure 4.1.

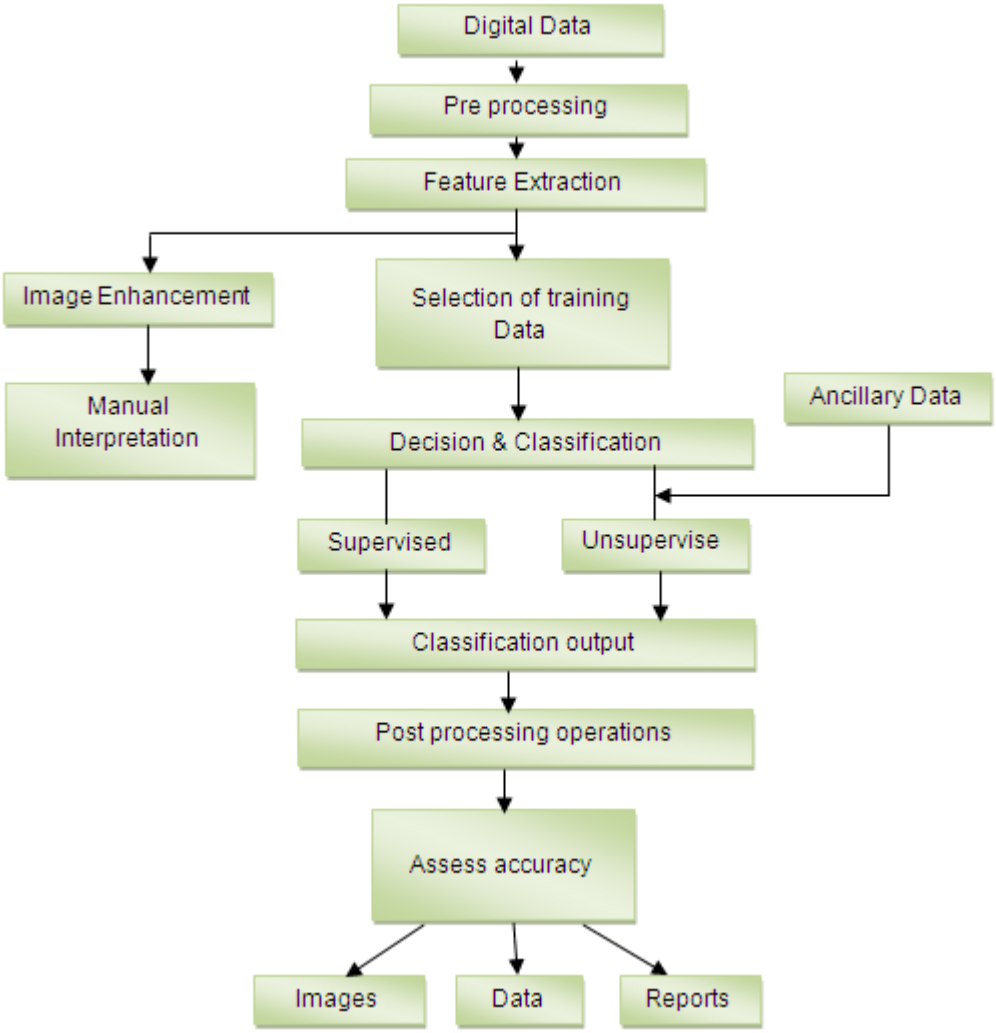

Figure 4.1: Flowchart Showing Different Phases in Digital Image Processing [5]

4.3.2 Algorithm of Flowchart of Sensor

The operating mechanism of HC-SR04 is as shown in the Figure 4.2. Colors change at certain distances with RGB.

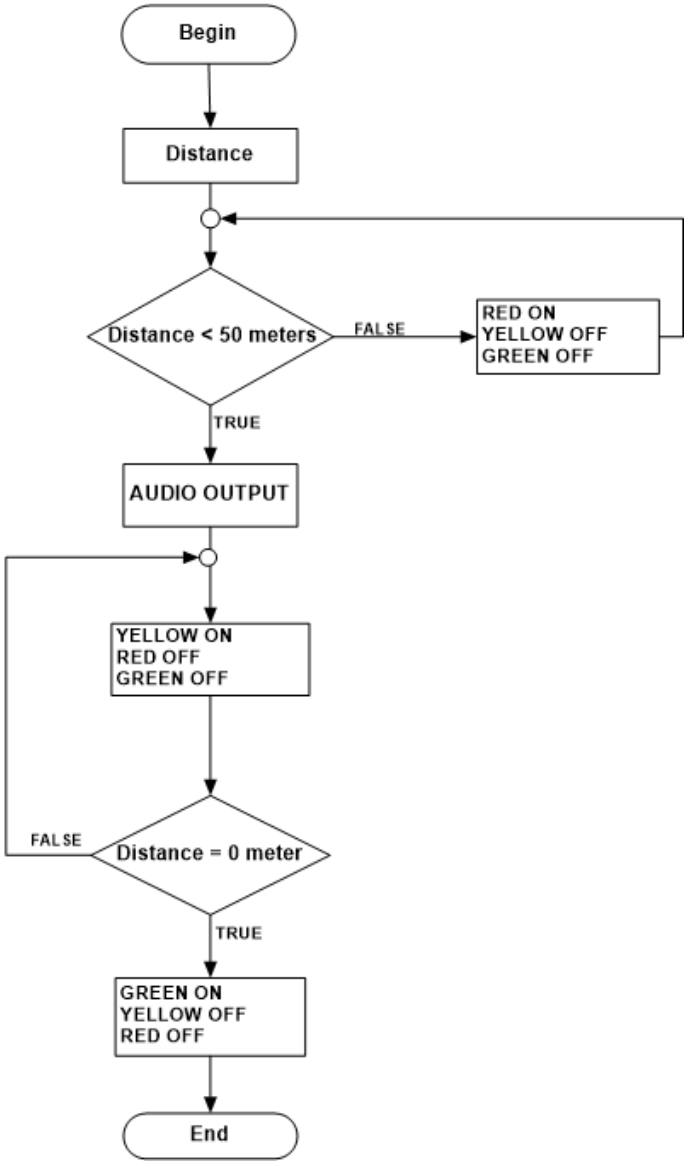

Figure 4.2: Flowchart of Ultrasonic Sensor (HC-SR04)

5. HARDWARE DESCRIPTION OF THE PROJECT

5.1 Arduino

Ardunio is an open source development platform where you can develop various projects without requiring a high degree of electronic and microcontroller knowledge. It is necessary to know the working logic and connection structure of the circuit elements to be used with Arduino. Different arduino development card models are available for different projects. The arduino uno you see below is ideal for start-up and has enough equipment to do basic projects. Arduino nano-like models are used in projects where less hardware is required, while Arduino Mega models are preferred when a large number of pins are needed.

5.1.1 Arduino UNO R3

Arduino is an electronic hardware and software based development platform. Students can also do projects with professional knowledge, for educational purposes or for professional purposes with the basic knowledge, without having very detailed programming and electronic knowledge as well as with Arduino. Arduino Uno is the most widely used and best known model. Launched in 2010 [18]. It is shown in Figure 5.1.

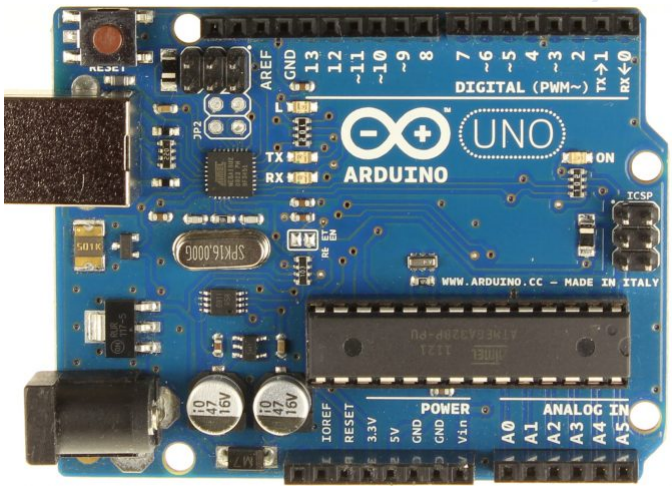

Figure 5.1: Part of Arduino UNO R3 [18]

Physical information is available from various sensors. It is possible to perform various experiments with this information. In addition, motor, LED, buzzer, such as an output can be obtained from stimuli. Basic programming knowledge is sufficient to control such electronic components by connecting them to the Arduino Uno board. While the size is much smaller and much larger, the size of the Arduino Uno is the most standard in terms of projects. The presence of 14 digital output pins means that 14 different digital sensors and stimuli can be controlled. 5 of these digital outputs are PWM outputs. The speed of the motors, the brightness levels in the LEDs, as well as the stimulants that are to be controlled analogly, are controlled by connecting them to the PWM pins. The 6 analog inputs in the Arduino Uno are for sensors with which we can receive analog input signals [18]. It is shown in Table 6.1.

Table 5.1: Part of Arduino UNO R3 [19]

Number	**Name Of Part**
1	USB jack
2	Power jack (7-12 V DC)
3	Microcontroller ATmega328
4	Communication chip
5	16 MHz crystal
6	Reset button
7	Power LED
8	TX / NX LEDs
9	LED
10	Power pins
10	Analog inputs
11	Analog inputs
12	TX / RX pins
13	Digital input / output pins
14	Ground and AREF pins
15	ICSP for ATmega328
16	ICSP for USB interface

More advanced projects such as drone, robot, smart home automation, burglar alarm system, parking sensor are also among the most basic applications such as LED flashing with Arduino Uno. This completely depends on which application is desired. In short, the Arduino Uno is a control card of standard sizes, allowing you to control electronic circuits in many applications from simple to difficult.

Arduino Uno can communicate in many ways. Serial communication with RX and TX pins is possible. Atmega16u2 USB-to-serial converter also enables communication between the Atmega328 and the computer by opening a virtual serial port on the computer. The Arduino IDE allows for sending and receiving text-based information between the serial monitor and the Arduino. When there is a communication between the Arduino and the computer via the USB, the LEDs on the Arduino on RX and TX light up. Arduino Uno normally has one serial port, but with SoftwareSerial library, this number can be incrementally increased. Atmega328 also provides I2C and SPI ports. The Wire library in the Arduino IDE is used to provide I2C and the SPI library to provide SPI communication [19].

5.2 Ultrasonic Sensor (HC-SR04)

HC-SR04 is a device used for distance measurement using sound waves. It contains a transmitter and a receiver for sound waves. By transmitting sound waves over the transmitter, it offers the possibility of measuring distance over the time between these waves hitting a surface and returning. It is able to measure between 2 and 400 cm and can measure this with a precision of 3 mm. It is used with connections to the VCC, Trigger, Echo and GND legs on the 5V operating voltage [20].

A sound wave is emitted from the transmitter. The HC-SR04 applies a voltage to the Echo leg when the emitted sound wave is reflected on the receiver by a reflection from a surface with the application of the voltage by activating the Trigger leg 14. The distance in front of the sensor is calculated using the time elapsed between the broadcast and the reflection of the sound wave. The features of the Ultrasonic Sensor (HC-SR04) are also shown in the Table 5.2.

Table 5.2: Features of Ultrasonic Sensor(HC-SR04) [20]

PART	**Features**
Working Voltage	DC 5V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	$10\mu STTLpulse$
Dimension	45 * 20 * 15mm

The operating principle is as follows: The signal applied from the Trig pin of the sensor provides an ultrasonic sound propagation at a frequency of 40 kHz. When this sound wave hits any object and returns to the sensor, the Echo pin is activated. The distance of the object to the sensor can be determined by measuring the time between these two signals.It is shown in Figure 5.2.

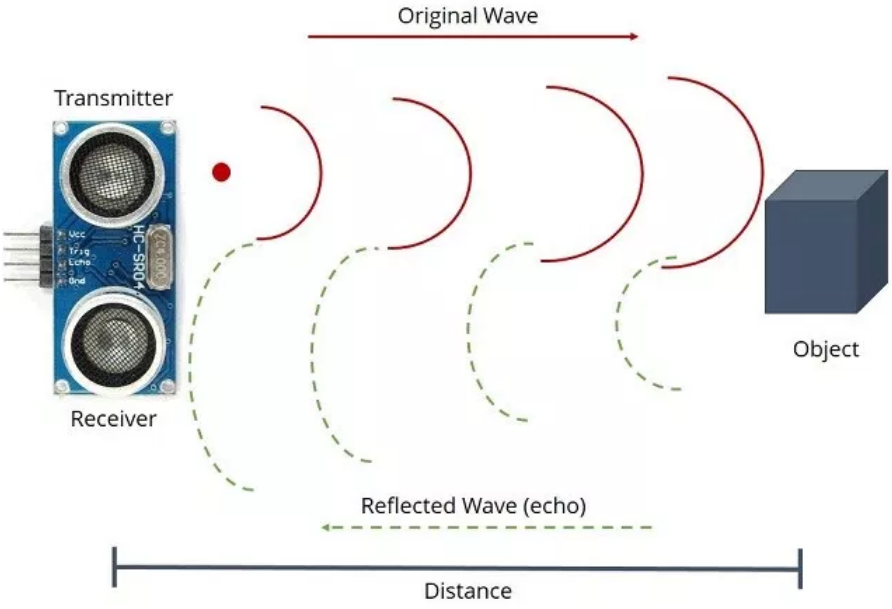

Figure 5.2: Detection Of the Distance of the Object to the Sensor [20]

5.2.1 Arduino and HC – SR04 Sensor Connection

This sensor is really usable and popular among the Arduino tinkerers. The ultrasonic sensor reads and writes the distance to an object in the serial monitor in this project .The connection is shown Table 5.3 and schematic diagram Figure 5.3.

Table 5.3: Arduino and HC – SR04 Sensor Connection

HC-SR04	**Arduino**
Vcc	5V
Trig	Pin 11
Echo	Pin 12
GND	GND

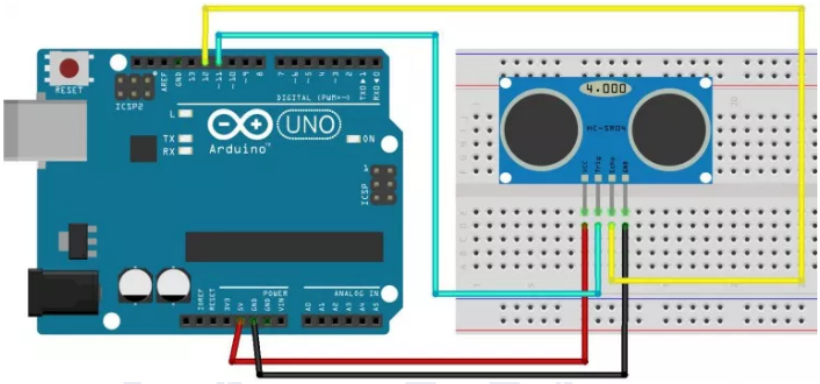

Figure 5.3: Schematic Diagram to Wire the HC-SR04 to the Arduino [20]

5.3 Sound System Equipment

The distance between the train and the stop will be 50 meters. This will be the command to prepare. It will be a nice application especially for visually impaired people. To play audio from SD Card using Arduino, we need audio files in WAV format. The Arduino Board can play an audio file in a specific format in wav format. To make an arduino mp3 player, there are many mp3 shields you can use with your arduino. To play mp3 files in Arduino, there are websites that you can use to convert any audio file on your computer to that specific WAV file [21]. Schematic diagram is shown Figure 5.4.

Hardware Required:

1. Arduino UNO
2. SD Card Reader module
3. SD card
4. LM386 Audio Amplifier
5. 2 units 10uF Capacitor
6. 2 units 100uF Capacitor
7. 1K,10K Resistor
8. 2 units Push buttons
9. Breadboard
10. Connecting Wires

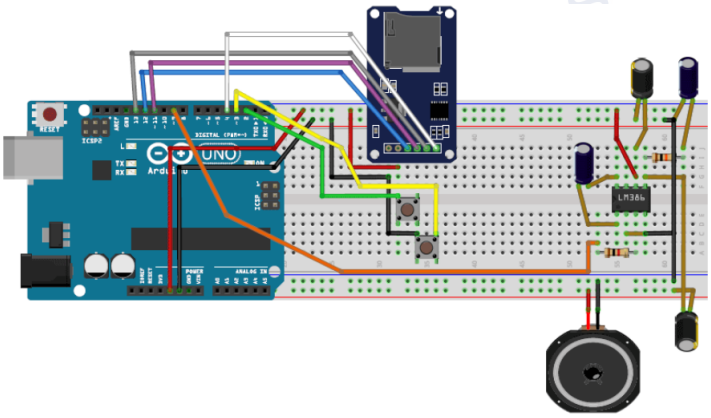

Figure 5.4: Over a Breadboard of Circuit [21]

The audio files are saved on the SD card. So we can create an SD card reader module with Arduino. The Arduino and SD card communicate using the SPI communication protocol [28]. Therefore, the module is interfaced with the SPI pins of the Arduino as shown in the diagram above. The following Table 6.4 is also listed separately. It is also is shown circuit diagram in Figure 5.4.

Table 5.4: Module is Interfaced with the SPI Pins of the Arduino [21]

Arduino	**SD Card Module**
+5V	Vcc
GND	GND
Pin 12	MISO (Master In Slave Out)
Pin 11	MOSI (Master Out Slave In)
Pin 13	SCK (Synchronous Clock)
Pin 4	CS (Chip Select)

5.4 RGB And Arduino UNO Connection

RGB (Red-Green-Blue) is a LED that contains red, green and blue colors. It is especially used in animation and lighting systems. RGB LEDs are available for each color. Thanks to these ranges it is possible to obtain many colors.

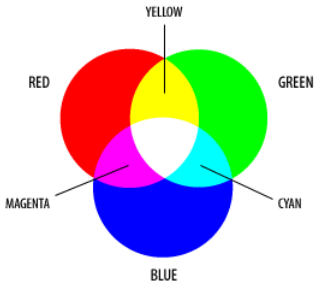

Figure 5.5: Using Red, Green and Blue Colors to Create other Colors [22]

It is possible to regulate the color intervals of the related color ranges, to be completely burned out, completely extinguished or partially burned. RGB LEDs have two types, common anode and common cathode. Therefore, the circuit diagram must also be set correctly according to the RGB LED used. Common cathode LEDs are activated by the positive edge trigger of the PWM signal, while the common anode LEDs are the opposite [23].

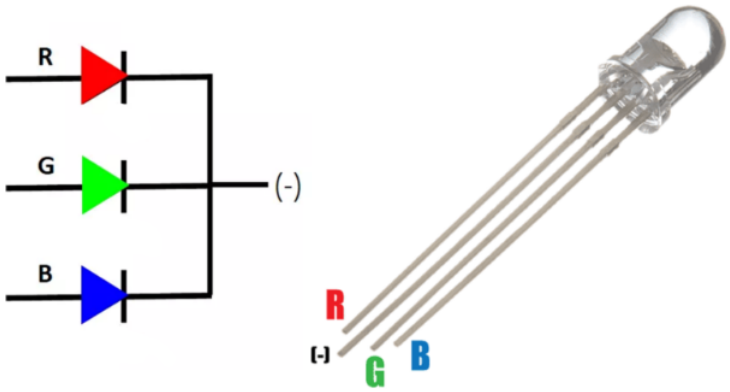

Figure 5.6: A Common Anode RGB LED [22]

The RGB LED will illuminate between 0-255. The LED is brightest at 5 Volts. In order to obtain intermediate values, Arduino's pulse width modulation terminals must be used.

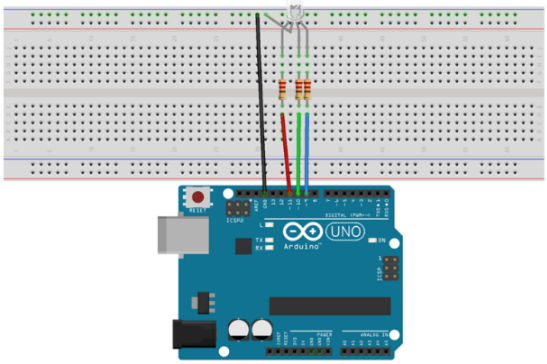

Figure 5.7: Relationship Arduino UNO and RGB [22]

5.5 Webcam

A real-time camera is used and real-time images are taken in this thesis. Thousands of kinds of Webcams are available. With the help of web cameras, it is possible to perform video and audio calls directly from the camera, through which you can make photos, videos or snapshots. However, a high-resolution Webcam should be used when shooting images. The image here is in direct communication with the computer, so you need a good camera. It can also be used with a light-controlled camera with a resolution of 1600x1200 pixels. A camera with a viewpoint and how many degrees of view should be used will be achieved with the help of the applications in the spring semester for this project.

5.6 Computer

A computer is needed to use the microprocessor. The microprocessor and computer will be connected in series. A hardware is required to process the resulting image. In fact, one of the purposes of the project is computer imaging. This application can be done with today's computers. The importance of the computer used is quite high. The properties of the computer used are shown in the Table 5.5.

Table 5.5: The Userable Values for a Computer

Features	**Minimum required value**
Graphics Card Memory	4 GB
Screen Size	15.6 inches
Ram (System Memory)	12 GB
Processor Type	Intel Core i5
Hard Drive Capacity	1TB

6. WORK PLAN

6.1 Timeline for Report

This research report was made with the advisor spread over a period of time. Focused on the subject and investigated methods with advisor some weeks. As a result of these negotiations, the desired subjects were investigated. Research on image processing was carried out. HOG detector was learned what works. The existing hardware investigated. Available libraries and interfaces have been researched for this project. It was obtained information about the distance sensors. Researches have been made on the compatibility of these.

It was be researching and purchasing used materials and software applications in fall spring. The equipment to be used was be ordered. There was be enough information for image processing. OpenCV library and interface as Python was be used . It was be obtained the development of this software. It was be provided serial communication to Arduino between the computer. Applications was be made for distance sensor. Then they was be connected with each other. The project was be completed by making various testing. This final report is shown step by step in the Table 6.1.

Table 6.1: Gantt Chart of Project

Gantt chart	Oct				Nov				Dec				Feb				Mar				Apr				May			
Weeks	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Researching image processing and HOG detector																												
Library and interface programs for software																												
Comparison of various distance sensors																												
Hardware studies and development of these studies																												
Preparation of research report																												
Researching and purchasing used materials and software applications																												
Implementation of applications software and hardware																												
Testing hardware and software applications under different conditions																												
Preparation of final report																												

6.2 Cost Analysis

This project is mostly software based. Therefore, there is not much cost for hardware. Of course, the project must have certain limitations. That is the definition of engineering. As soon as possible, at least cost, the most efficient result. Some programs have licensing costs. For example, programs like Matlab. But it can be used in the school lab. However, the OpenCV library will be used in this project. Pyhton will be used as interface. This programs do not have licensing costs. Capacitor, resistance, breadboard is not included to exist in this cost analysis. Arduino, LED, Webcam, HC-SR04 and Sound System materials will used. The cost of these materials is shown in Table 6.2.

Table 6.2: Cost Analysis

Material	**Cost**
ARDUINO	USD 7.00
WEBCAM	USD 4.50
RGB	USD 2.25
HC-SR04	USD 2.50
SD CARD (2GB)	USD 2.50
SD CARD MODULE	USD 4.25
SPEAKER	USD 2.5
TOTAL	USD 25.50

7. APPLICATIONS AND RESULTS

7.1 Activation of HC-SR04 and RGB in Arduino

The voltage used in the input / output pins of the Arduinon is 5V. The LED is connected to the board to draw 20 mA current at 5V voltage. When connected in this way, the LED will light up as bright as possible. The answer is actually simple: lower the voltage. If the 5V LED is operated with a lower voltage, eg 3V, its brightness will be reduced. But this time the following liveable: Arduino output voltage 5V was not? How to get 3V output? It is necessary to use pulse width modulation technique. The PWM enables the desired voltage from 0 to 5V to be removed from the output pin of the Arduino by switching on and off the 5V voltage at the output at a specific time interval (usually 1 / 500th of a second in Arduino). If an LED flashes too quickly, the eye cannot fully detect this blinking and perceive the brightness to be lower.

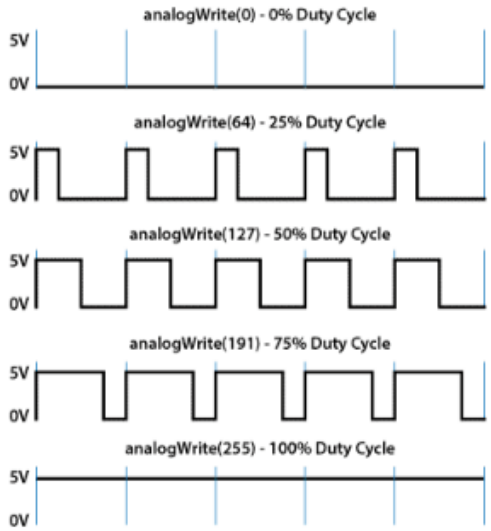

Figure 7.1: Pulse Width Modulation of Ardunio Output Voltage [23]

As shown in Figure 7.1, if 5V is given in only percent 5 of 2 milliseconds, percent 5 of 5V is obtained; ie it will be 0.25V. Similarly, if 2 ms is set to remain open percent 50 for 2 ms, 2.5V is obtained. Not all pins of the Arduino UNO are capable of PWM output. There are some pins with a mark in front of the pin number on the card's digital pins. These pins must be used if you want to receive PWM output. These pins are pins 3, 5, 6, 9, 10 and 11 for the Arduino UNO. It is show this mixture in Figure 7.2.

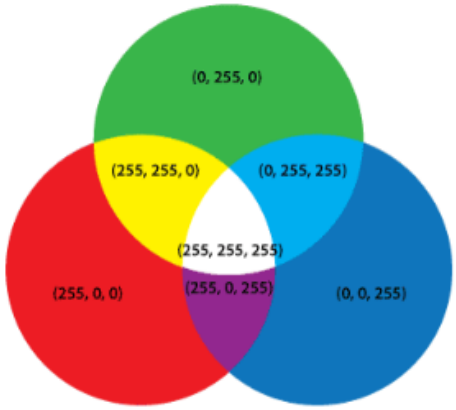

Figure 7.2: To Mix Red, Blue and Green Light to Obtain the Desired Light [22]

In addition, the analogWrite command in the function called ColorSet enables us to adjust the height of the voltage received from each PWM output pin. In the analogWrite command, the value 255 represents the maximum output voltage, ie 5V. All values from 0 to 255 correspond to the voltage values from 0 to 5V. For example, the analogWrite (9, 80) command enables output from pin 9 to 5V x (80/255) = 1.57V. It is possible to mix the red blue and green light of different brightness to obtain the desired color light.

7.2 Results of Parameter Sets Used At Different Conditions

In the image processing, the angle of the image to be taken from the camera with the camera is very important. Because it is necessary for the accuracy of the project. Therefore, some images were obtained at the angles determined in this final report.

The angle of the sensor is also very important. Because the receiver of the distance sensor is parallel to the transmitter part. Therefore, the sensor must be hung at an angle to the ceiling.

In this project, optimum results were not obtained. The space required for this project must be very large. But approximately HC-SR04 and the camera can be mounted at an angle of -30 degrees. Of course, the conditions must be appropriate for this. HC-SR04 will be hung on the ceiling of the entrance of the station. For this, a distance of 50 meters should be flat.

Images taken in this project are due to exceeding the line of infringement. When the LED light is red, it means warning. One or someone is very close to the rail and in danger. The red illumination of RGB is the state of the train's distance from the station to more than 50 meters. In case of yellow burn, the difference between the train's distance and the distance of the train is zero. Green is the status of the train to the station. That means that the train can be boarded. In fact, RGB has brought an aesthetic touch to this project. It also provides convenience for hearing impaired people. They can live the moment like normal people. When RGB lights up yellow, it will be able to take its position, and when it glows green, they will get on the train. This project requires larger areas and larger image processing cameras to sharpen the camera angle.

The program in Figure 7.3 is the hercules program. This problem has helped a lot in this project. This program shows the output in COM6. It means that the 3 trains here are not near the station. So he says the camera is on. Any danger will also give the LEDs warning. 1 means that the train is at the station and the passengers get on the train. Therefore, the camera is disabled.

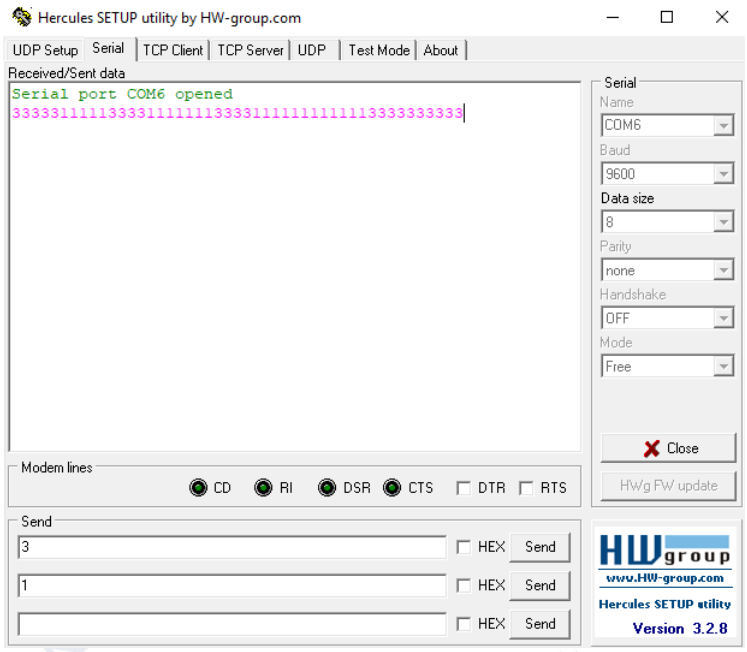

Figure 7.3: Hercules 3 and 1 Status to the Circuit Reflection

The Situation Where The Train is Far from the Station and No Violation:

Figure 7.4: The Area where the Camera Sees and No One Violates Line

This Figure 7.4 was been a green square when someone breaks the line of warning. Nobody's breaking the line right now. There is no one in the camera's field of application. So the LED doesn't light up. No warning.

The Situation Where The Train is Far from the Station and Violation: In this Figure 7.6 one person violated the line. The status of RGB is also shown in the Figure 7.7. The train has more than 50 meters to enter the station.

In addition, the camera can detect and alert the whole body even in different ways.

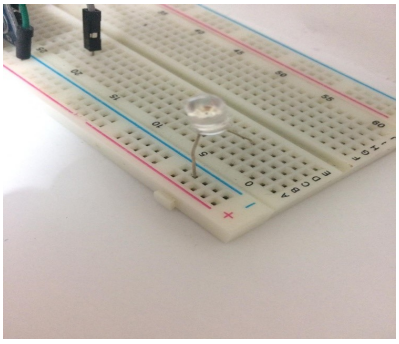

Figure 7.5: Indication of the Absence of Anyone in the Application Area of the Camera

For example, the train is less than 50 meters from the station. This situation was shown in the Figure 7.8, 7.9, 7.10 and 7.11.

The situation of the train in the station:In this case the line was been violated. But because the RGB lights up green, the camera was been disabled.This situation was shown in the figure 7.12 and 7.13.

Reflections of Python code: The upper body, full body or face recognition can only be performed in the code. Fullbody was selected in this project.It was shown figure 7.14 and 7.15.

Figure 7.6: There is One Person in the Area That the Camera Sees

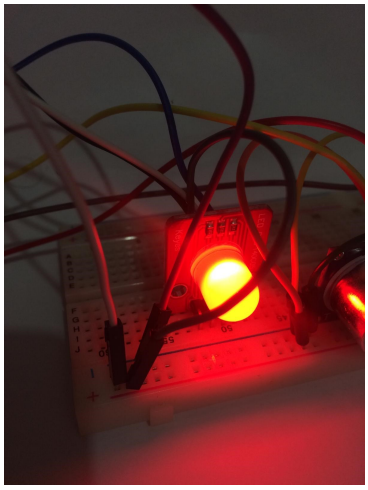

Figure 7.7: RGB's status

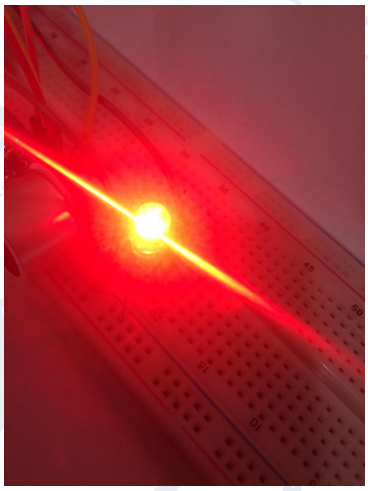

Figure 7.8: LED Gives Warning

Figure 7.9: Condition of the Camera in Different Body Condition

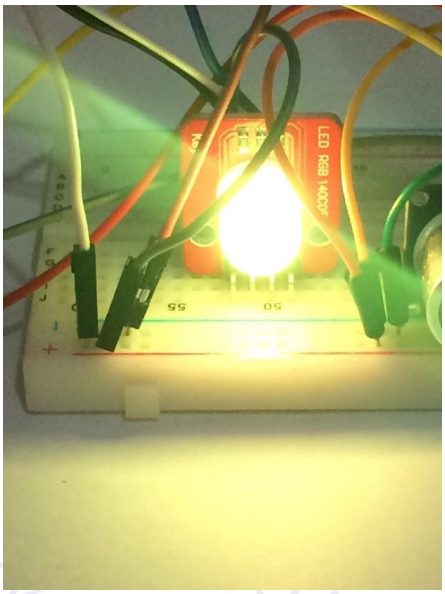

Figure 7.10: Status of RGB

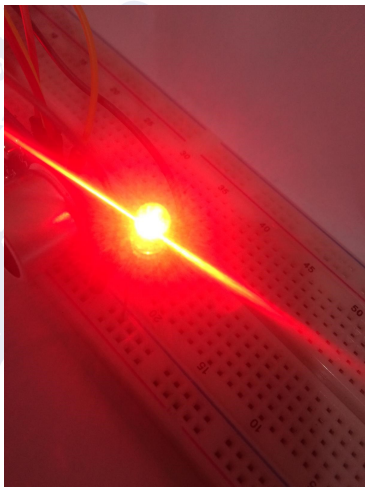

Figure 7.11: Status of LED

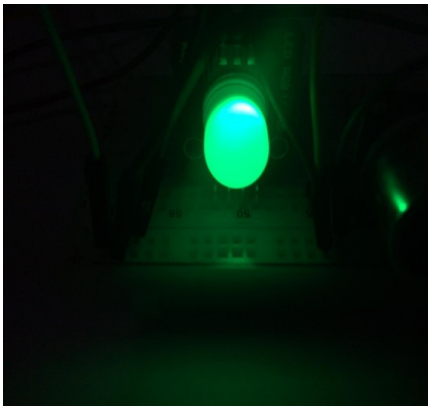

Figure 7.12: RGB Green on Fire

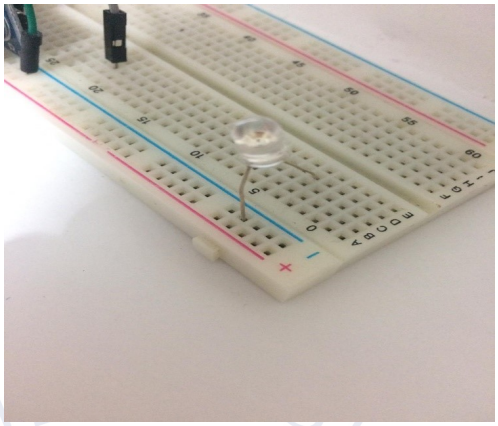

Figure 7.13: Camera Access is Blocked Status of LED

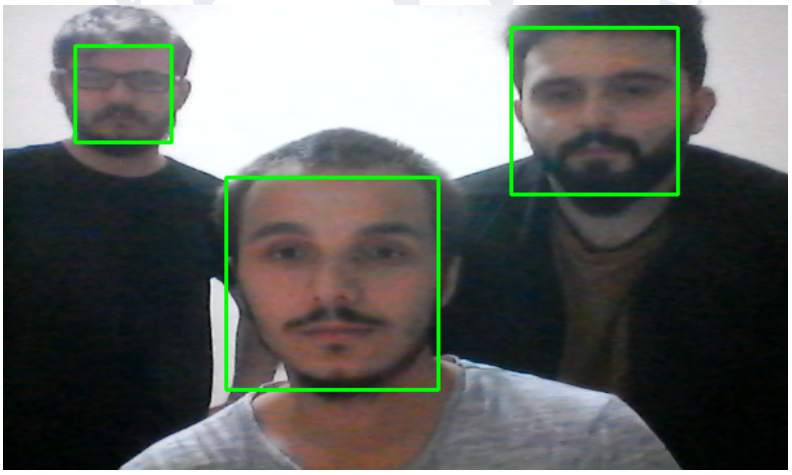

Figure 7.14: Face Recognition, Pulling Face Recognition from an XML File

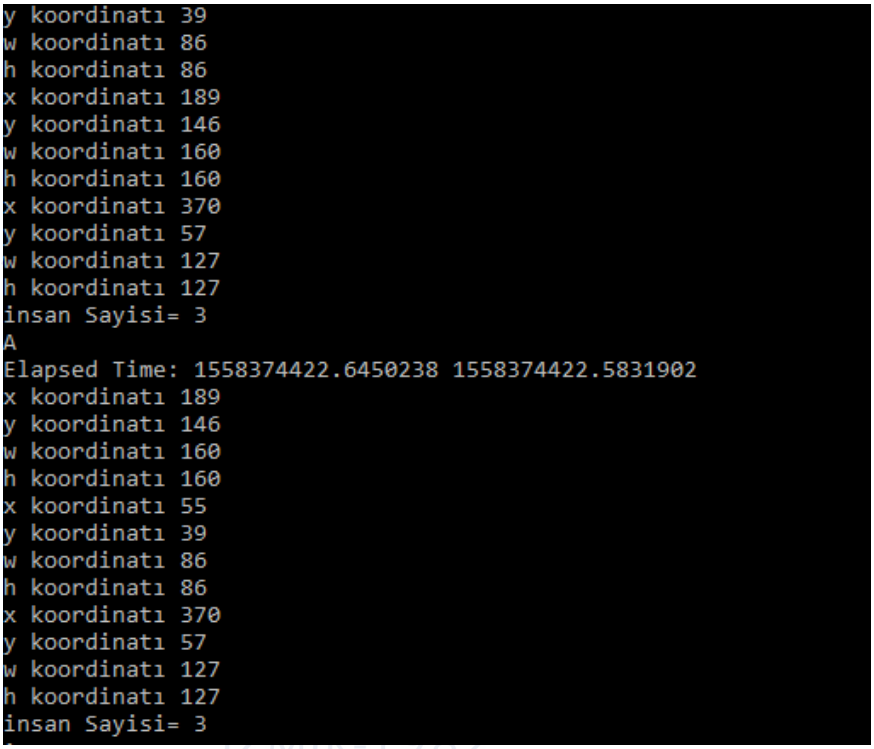

Figure 7.15: Python Output Based on Code

8. STANDARDS

Arduino Communication Standards: Arduino offers a variety of possibilities for communication with a computer, another Arduino or with other microcontrollers. The Arduino microcontroller TTL (5V) has 4 hardware UARTs for serial communication. The 16U2 on the card channels the serial communication via USB and appears on the computer as a virtual com port. Uses 16U2 standard USB com drives and does not require an external drive. However, an .inf file is required in Windows. The RX and TX LEDs on the board flash when the data is transferred from the USB to the serial chip and from USB to the computer. The SoftwareSerial library allows serial communication over any of Arduino's digital pins.The Arduino ISP can also be used to disable the Arduino's bootloader and program the microcontroller via the ICSP (In Circuit Serial Programming Pin).

Arduino Programming Standards: A bootloader was previously installed on the microcontroller on the Arduino. With this bootloader, there is no need for an external programmer hardware to program the Arduino. Communicates using the original STK500 program.

Hercules Standards: Hercules SETUP utility is useful serial port terminal (RS-485 or RS-232 terminal), UDP/IP terminal and TCP/IP Client Server terminal. It was created for HW group internal use only, but today it's includes many functions in one utility and it's Freeware! With our original devices (Serial/Ethernet Converter, RS-232/Ethernet Buffer or I/O Controller) it can be used for the UDP Config.

Other Standards: Red LED on the ground means warning. It will give a warning when the violation line is exceeded.Some guidelines should be followed when writing Python code. Patches and additions to any code base will be checked for adherence to these guidelines. In addition universal python coding, error detection and correction, and the Internet protocol used in the interface, such as TCP / IP communication standards have been used by selecting the appropriate ones.

9. CONCLUSION

In this project, human screening was aimed with HOG. A system was been designed to alert as a result of the violation. HOG is used not only for recognition but also for feature extraction in the recognition of different objects. HOG is a technology that shaped the last period. Implementation of OpenCV has been performed.

In order to facilitate the learning and teaching of computer image processing, a program should have several features, such as using freeware, not requiring extra program installation, being user friendly, not requiring programming skills and technical information, and so on. Moreover, users can employed it without time and location restraints. So, OpenCV and Python was used for this project. Ultrasonic Sensor sends ultrasonic waves from a emitter to a sensor object, then receives the reflected waves by a detector. The sensor uses the obtained information to determine the presence of an object or to measure the distance to the object. This type of sensor determines the distance from the sensor to the object,depending on the time it takes until the ultrasonic waves are received at the speed of sound. The red light means that the train is not around, with the help of this sensor. The yellow light means that the train is approaching and that the train can be taken in the green light. The important point here is that when the train arrives at the station, the camera will leave the system because the line of violation will be overcome. This problem was resolved at the end of long studies. When the RGB lights green, the camera in the system loses its function. An aesthetic environment has been created with the help of this sensor.

As a result, Arduino and the computer was been serial communication. As a result of the combination of these systems, the project was provided safe access to people.

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