A

Major Project Report

On

"GARBAGE DETECTION USING IMAGE PROCESSING"

Submitted in partial fulfillment of the
Requirements for the award of the degree of

Bachelor of Technology

In

Computer Science & Engineering

By

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Under the guidance of

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2020

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CERTIFICATE

This is to certify that the project entitled **"GARBAGE DETECTION USING IMAGE PROCESSING"** by **N. Ganesh (16R21A0580), N. Likhitha (16R21A0598), P. Varesh (16R21A05A5), B.Jagadeesh (16R21A0567)** has been submitted in the partial fulfillment of the requirements for the award of degree of Bachelor of Technology in Computer Science and Engineering from MLR Institute of Technology, Hyderabad. The results embodied in this project have not been submitted to any other University or Institution for the award of any degree or diploma.

Internal Guide
Kashi Sai Prasad

Head of the Department
Prof N Chandra Shekhar Reddy

External Examiner

DECLARATION

We hereby declare that the project entitled **"GARBAGE DETECTION USING IMAGE PROCESSING"** is the work done during the period from **January 2020 to April 2020** and is submitted in the partial fulfillment of the requirements for the award of degree of Computer Science and Engineering from MLR Institute of Technology, Hyderabad. The results embodied in this project have not been submitted to any other university or Institution for the award of any degree or diploma.

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ABSTRACT

Garbage is a big global problem causing diseases spread. We consume many things and throw them, once they are used in the form of garbage or waste disposal which causes a major ecological problem. The Garbage Waste Detection using Image Processing is the solution for this problem. Here we use the technique of image processing to identify the garbage waste. The method of image processing is used to do some processes on a picture. The idea of Garbage Identification and sending information to collect the garbage will help in keeping the environment clean.

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1. INTRODUCTION

INTRODUCTION

In today's world, garbage disposal has become a cause of major concern. An astounding amount of0.1 million tons of waste is generated each day in our country. Unfortunately, only 5% of this colossal amount of waste is recycled. The huge amount of waste that is generated gets disposed by means which have an adverse effect on the environment due to improper waste management. Several advancements in technology has made it possible to convert waste items into useful sources of energy. But, to enable the waste items to be used as sources of energy, they need to be carefully processed and any non-biodegradable waste item needs to be removed. We have different methods to separate the garbage depending upon the material. There are various waste monitoring and management systems which are used for different purpose. This system helps us to detect the garbage which are thrown along the roadsides and public places. Once this garbage is detected the concern department will be informed about this and they will take necessary action.

ARTIFICIAL INTELLIGENCE

An AI system is composed of an agent and its environment. An agent(e.g., human or robot) is anything that can perceive its environment through sensors and acts upon that environment through effectors. Intelligent agents must be able to set goals and achieve them. In classical planning problems, the agent can assume that it is the only system acting in the world, allowing the agent to be certain of the consequences of its actions. However, if the agent is not the only actor, then it requires that the agent can reason under uncertainty. This calls for an agent that cannot only assess its environment and make predictions but also evaluate its predictions and adapt based on its assessment.

Natural language processing gives machines the ability to read and understand human language. Some straightforward applications of natural language processing include information retrieval, text mining, question answering and machine translation.

Machine perception is the ability to use input from sensors (such as cameras, microphones, sensors etc.) to deduce aspects of the world. e.g., Computer Vision. Concepts such as game theory, decision theory, necessitate that an agent be able to detect and model human emotions.

Many times, students get confused between Machine Learning and Artificial Intelligence but Machine learning, a fundamental concept of AI research since the field's inception, is the study of computer algorithms that improve automatically through experience. The mathematical analysis of machine learning algorithms and their performance is a branch of theoretical computer science known as computational learning theory.

Stuart Shapiro divides AI research into three approaches, which he calls computational psychology, computational philosophy, and computer science. Computational psychology is used to make computer programs that mimic human behavior. Computational philosophy is used to develop an adaptive, free-flowing computer mind. Implementing computer science serves the goal of creating computers that can perform tasks that only people could previously accomplish.

ANDROID

Android is an open source and Linux-based Operating System for mobile devices such as Smartphone and tablet computers. Android was developed by the Open Handset Alliance, led by Google, and other companies.

Android operating system is a stack of software components which is roughly divided into five sections and four main layers as shown in the architecture diagram. Android is a mobile operating system based on a modified version of the Linux kernel and other open source software, designed primarily for touchscreen mobile devices such as smartphones and tablets. Android is developed by a consortium of developers known as the Open Handset Alliance and commercially sponsored by Google. It was unveiled in 2007, with the first commercial Android device launched in September 2008.

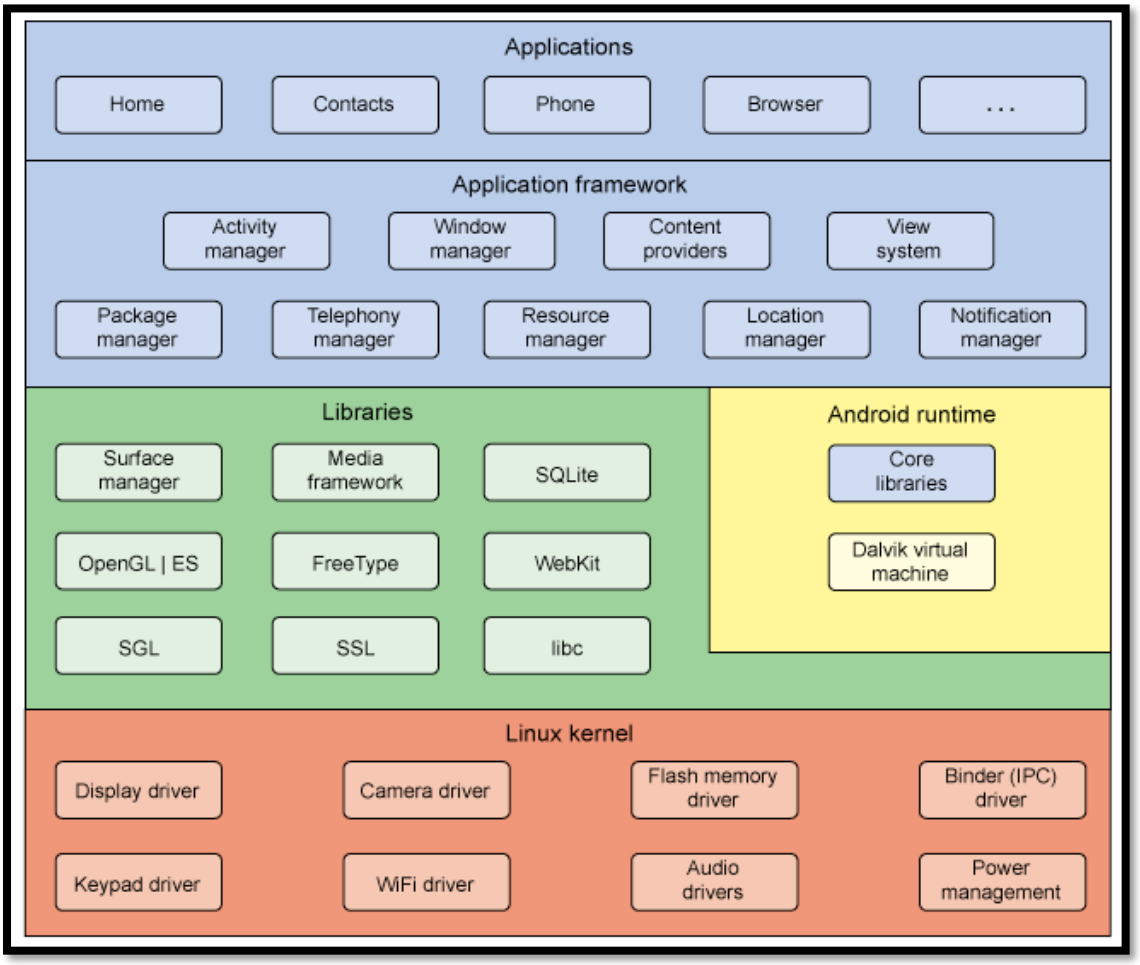


Fig 1.1: Architecture of Android

It is free and open source software; its source code is known as Android Open Source Project (AOSP) which is primarily licensed under the Apache License. However most Android devices ship with additional proprietary software pre-installed,most notably Google Mobile Services (GMS)which includes core apps such as Google Chrome, the digital distribution platform Google Play and associated Google Play Services development platform. About 70 percent of Android smartphones run Google's ecosystem;competing Android ecosystems and forks include Fire OS (developed by Amazon.com), or LineageOS (which is community-maintained). However the "Android" name and logo are trademarks of Google which impose standards to restrict "uncertified" devices outside their ecosystem to use Android branding.

The source code has been used to develop variants of Android on a range of other electronics, such as game consoles, digital cameras, PCs and others, each with a specialized user interface. Some well known derivatives include Android TV for televisions and Wear OS for wearables,

both developed by Google. Software packages on Android, which use the APK format, are generally distributed through proprietary application stores like Google Play Store or Samsung Galaxy Store, or open source platforms like Aptoide or F-Droid.

Android has been the best-selling OS worldwide on smartphones since 2011 and on tablets since 2013. As of May 2017, it has over two billion monthly active users, the largest installed base of any operating system, and as of March 2020, the Google Play Store features over 2.9 million apps.The current stable version is Android 10, released on September 3, 2019.

Linux kernel

At the bottom of the layers is Linux - Linux 3.6 with approximately 115 patches. This provides a level of abstraction betIen the device hardware and it contains all the essential hardware drivers like camera, keypad, display etc. Also, the kernel handles all the things that Linux is really good at such as networking and a vast array of device drivers, which take the pain out of interfacing to peripheral hardware.

Libraries

On top of Linux kernel there is a set of libraries including open-source Ib browser engine Ib Kit, Ill known library, SQLite database which is a useful repository for storage and sharing of application data, libraries to play and record audio and video, SSL libraries responsible for Internet security etc.

Android Libraries

This category encompasses those Java-based libraries that are specific to Android development. Examples of libraries in this category include the application framework libraries in addition to those that facilitate user interface building, graphics drawing and database access. A summary of some key core Android libraries available to the Android developer is as follows −

- **android.app** − Provides access to the application model and is the cornerstone of all Android applications.
- **android.content** − Facilitates content access, publishing and messaging betIen applications and application components.

- **android.database** − Used to access data published by content providers and includes SQLite database management classes.
- **android.opengl** − A Java interface to the OpenGL ES 3D graphics rendering API.
- **android.os** − Provides applications with access to standard operating system services including messages, system services and inter-process communication.
- **android.text** − Used to render and manipulate text on a device display.
- **android.view** − The fundamental building blocks of application user interfaces.
- **android.widget** − A rich collection of pre-built user interface components such as buttons, labels, list views, layout managers, radio buttons etc.
- **android.Ibkit** − A set of classes intended to allow Ib-browsing capabilities to be built into applications.

Having covered the Java-based core libraries in the Android runtime, it is now time to turn our attention to the C/C++ based libraries contained in this layer of the Android software stack.

Android Runtime

This is the third section of the architecture and available on the second layer from the bottom. This section provides a key component called **Dalvik Virtual Machine** which is a kind of Java Virtual Machine specially designed and optimized for Android.

The Dalvik VM makes use of Linux core features like memory management and multi-threading, which is intrinsic in the Java language. The Dalvik VM enables every Android application to run in its own process, with its own instance of the Dalvik virtual machine.

The Android runtime also provides a set of core libraries which enable Android application developers to write Android applications using standard Java programming language.

Application Framework

The Application Framework layer provides many higher-level services to applications in the form of Java classes. Application developers are alloId to make use of these services in their applications.

The Android framework includes the following key services −

- **Activity Manager** − Controls all aspects of the application lifecycle and activity stack.
- **Content Providers** − Allows applications to publish and share data with other applications.

- **Resource Manager** − Provides access to non-code embedded resources such as strings, color settings and user interface layouts.
- **Notifications Manager** − Allows applications to display alerts and notifications to the user.
- **View System** − An extensible set of views used to create application user interfaces.

Application components are the essential building blocks of an Android application. These components are loosely coupled by the application manifest file *AndroidManifest.xml* that describes each component of the application and how they interact.

There are following four main components that can be used within an Android application –

Table : Components in Android

Sr.No	Components & Description
1	**Activities** They dictate the UI and handle the user interaction to the smart phone screen.
2	**Services** They handle background processing associated with an application.
3	**Broadcast Receivers** They handle communication betIen Android OS and applications.
4	**Content Providers** They handle data and database management issues.

Additional Components

There are additional components which will be used in the construction of above mentioned entities, their logic, and wiring betIen them. These components are –

Table :Components in Android(Continued)

Sl.No	Components & Description
1	**Fragments** Represents a portion of user interface in an Activity.
2	**Views** UI elements that are drawn on-screen including buttons, lists forms etc.
3	**Layouts** View hierarchies that control screen format and appearance of the views.
4	**Intents** Messages wiring components together.
5	**Resources** External elements, such as strings, constants and drawable pictures.
6	**Manifest** Configuration files for the application.

ANDROID OPERARING SYSTEM LIST

- Android 1.1
- Android 1.5 Cupcake
- Android 1.6 Donut
- Android 2.0 and 2.1 Éclair
- Android 2.2 Froyo
- Android 2.3 Gingerbread
- Android 3.0 and 3.1 Honeycomb
- Android 4.0 Ice Cream Sandwich
- Android 4.1, 4.2 and 4.3 Jellybean
- Android 4.4 Kit Kat
- Android 5.0, 5.1Lollipop
- Android 6.0 Marshmallow
- Android 7.0, 7.1 Nougat
- Android 8.0 Oreo

Motivation

The motivation for designing this "GARBAGE WASTE DETECTION USING IMAGE PROCESSING" is that to reduce the pollution and to provide cleanliness. The main motivation for this project was the slow and inefficient traditional manual system. So, why not make it automated fast and much efficiently. Also, such process of detection using image processing is very effective and helpful. We can achieve the cleanliness by this process and keeps society clean and neat.

Objective

1. To discover, verify and test new and important facts.
2. To analyze an event or process or phenomenon to identify the cause and effect relationship.
3. To develop new scientific tools, concepts and theories to understand scientific and nonscientific problems.
4. To find solutions to scientific, non-scientific and social problems.

Scope

¬ Provides facility for the automated attendance of students.

¬ Uses live face recognition to recognize each individual and mark their attendance automatically.

¬ Utilizes video and image processing to provide inputs to the system.

¬ Facility of marking manual attendance.

¬ Notification via email if there is a lack of attendance.

Organization of Documentation

The reminder of this document is first providing the full description of the project. It lists all the functions performed by the system. And it also concerns the details of the system functions and actions of each function which was performed by the system.

2. LITERATURE SURVEY

LITERATURE SURVEY

Introduction

In today's world, garbage disposal has become a cause of major concern. An astounding amount of 0.1 million tons of waste is generated each day in our country. Unfortunately, only 5% of this colossal amount of waste is recycled. The huge amount of waste that is generated gets disposed by means which have an adverse effect on the environment due to improper waste management. Several advancements in technology have made it possible to convert waste items into useful sources of energy. But, to enable the waste items to be used as sources of energy, they need to be carefully processed and any non-biodegradable waste item needs to be removed. We have different methods to separate the garbage depending upon the material. There are various waste monitoring and management systems which are used for different purposes. This system helps us to detect the garbage which are thrown along the roadsides and public places. Once this garbage is detected the concern department will be informed about this and they will take necessary action.

1. Existing System (Manual System)

The Manual system where GHMC people go along the way and collect the garbage using any kind of vehicle which is not possible for a proper maintenance of roadside waste. There are many diseases spread through the waste garbage. The old method is used by anyone who passes through garbage in the roadside area. They generally try to call municipal corporations and give complaints for the same. Their calls are not answered sometimes and many a time location is also a proper for identifying the garbage heap. The success rate of the garbage collected cannot be predicted in this case. It might take a lot many days to remove the waste garbage.

Disadvantages of Existing System

. Time consuming.

. Unnecessary fuel consumption.

. Increased noise and air pollution as a result of more trucks on the road.

2. Proposed System (Image processing)

The system helps us to detect the garbage which is thrown along the roadsides and public places. Once this garbage is detected the concern department will be informed about this and they will take necessary action. This is helpful for neat and clean society. This Method is very easy and helpful for everyone to keep surrounding clean. Our Application clicks an image and detects the garbage from the image. If the garbage is detected from the image then GPS location of the garbage from the app will be send to the concern department so that they will come and remove the waste garbage from the particular location. This will help us to keep our surroundings neat and clean.

Advantages of Proposed System

. Immediate response from the concerned department.

. Real time data transmission and access.

. Reduction in transportation costs can be witnessed.

. Cleanliness can be gained.

3. SYSTEM REQUIREMENTS

SYSTEM REQUIREMENTS

I. Technical Requirement

i. Hardware Requirements

- A standalone computer (i3 5th Gen, 8gb ram or higher).
- High-quality wireless camera to capture images.
- Secondary memory to store all the images and database.
- Android Mobile.

ii. Software requirements

- PyCharm professional 2017.2.4 or higher
- Python 3.5 or more
- Windows 8 or higher
- Latest version of all libraries
- Android operating system

II. Functional Requirements

System functional requirement describes activities and services that must provide.

¬ A user must be able to manage the database.

¬ An only authorized user must be able to use the system.

¬ A camera should have minimum megapixel.

III. Non-Functional Requirements

Non-functional Requirements are characteristics or attributes of the system that can judge its operation. The following points clarify them:

a. Accuracy and Precision: the system should perform its process with accuracy and precision to avoid problems.

b. Flexibility: the system should be easy to modify, any wrong should be correct.

c. Security: the system should be secure and saving student's privacy.

d. Usability: the system should be easy to deal with and simple to understand.

e. Maintainability: the maintenance group should be able to cope up with any problem when occurs suddenly.

f. Speed and Responsiveness: Execution of operations should be fast.

¬ The GUI of the system will be user-friendly.

¬ The data that will be shown to the users will be made sure that it is correct and is available for the time being. The system will be flexible to changes.

¬ The system will be extended for changes and to the latest technologies.

¬ Efficiency and effectiveness of the system will be made sure.

¬ The performance of the system will be made sure.

IV. User Requirements

¬ A user needs to take the picture of the particular garbage present area.

¬ He/She must enhance the image and then garbage identification will be done accordingly.

¬ A person should check for the detection of location and sending the information to the nearby GHMC department.

V. Administrator Requirements

¬ The administrator needs to log into the system at the time of registering the Municipal Department.

¬ He / She must make sure that the details are entered properly.

¬ Only the administrator has the rights to manage any changes in the system.

¬ Only the administrator is allowed to view the Training set and the Testing set.

¬ Only the administrator has the rights to manage any changes in the stored data set.

4. SYSTEM DESIGN

SYSTEM DESIGN

1. Android Studio

Android Studio was first announced at a Google I/O conference in 2013 and was released to the general public in 2014 after various beta versions. Prior to its release, Android development was handled predominantly through Eclipse IDE, which is a more generic Java IDE that also supports numerous other programming languages. Android Studio makes life significantly easier compared with non-specialist software, but is still has a little way to go before it can claim to be a completely intuitive and smooth experience. For complete beginners, there is an awful lot to learn here and much of the information available – even through official channels – is either out of date or too dense to make head or tails of. In this post, we'll explain what Android Studio does in a little more detail and go over the basic functionality that you need to get started. I'll try and keep everything as easy as possible and hopefully this will serve as the first step on your journey to Android Development. As an IDE then, Android Studio's job is to provide the interface for you to create your apps and to handle much of the complicated file-management behind the scenes. The programming language you will be using is either Java or Kotlin. If you choose Java, this will be installed separately on your machine. Android Studio is simply where you will write, edit and save your projects and the files that comprise said projects. At the same time, Android Studio will give you access to the Android SDK or 'Software Development Kit'. Think of this as an extension to the Java code that allows it to run smoothly on Android devices and take advantage of the native hardware. Java is needed to write the programs, the Android SDK is needed to make those programs run on Android and Android Studio has the job of putting it all together for you. At the same time, Android Studio also enables you to run your code, either through an emulator or through a piece of hardware connected to your machine. You'll then also be able to 'debug' the program as it runs and get feedback explaining crashes etc. so that you can more quickly solve the problem.

2. TensorFlow

TensorFlow is an open source framework developed by Google researchers to run machine learning, deep learning and other statistical and predictive analytics workloads. Like similar platforms, it's designed to streamline the process of developing and executing advanced analytics applications for users such as data scientists, statisticians and predictive modelers.

The TensorFlow software handles data sets that are arrayed as computational nodes in graph form. The edges that connect the nodes in a graph can represent multidimensional vectors or matrices, creating what are known as tensors. Because TensorFlow programs use a data flow architecture that works with generalized intermediate results of the computations, they are especially open to very large-scale parallel processing applications, with neural networks being a common example. The framework includes sets of both high-level and low-level APIs. Google recommends using the high-level ones when possible to simplify data pipeline development and application programming. However, knowing how to use the low-level APIs -- called TensorFlow Core -- can be valuable for experimentation and debugging of applications, the company says; it also gives users a "mental model" of the machine learning technology's inner workings, in Google's words. TensorFlow applications can run on either conventional CPUs or higher-performance graphics processing units (GPUs), as well as Google's own tensor processing units (TPUs), which are custom devices expressly designed to speed up TensorFlow jobs. Google's first TPUs, detailed publicly in 2016, were used internally in conjunction with TensorFlow to power some of the company's applications and online services, including its RankBrain search algorithm and Street View mapping technology. In early 2018, Google furthered its external TensorFlow efforts by making the second generation of TPUs available to Google Cloud Platform users for training and running their own machine learning models. TensorFlow-based workloads are billed on a per-second basis; the Cloud TPU service initially was launched as a beta program with only "limited quantities" of the devices available for use, according to Google. TensorFlow differs from DistBelief in a number of ways. Because TensorFlow was designed to be able to work separately from Google's own computing infrastructure, its code was more easily portable for outside uses. It's also a more general machine learning framework that isn't as tightly focused on neural networks as DistBelief was. Moreover, it's designed to support faster configuration and to run against the high-level APIs.

Applications

OpenCV's application areas include:

- 2D and 3D feature toolkits
- Ego motion estimation
- Facial recognition system

- Gesture recognition
- Human–computer interaction (HCI)
- Mobile robotics
- Motion understanding
- Object identification
- Segmentation and recognition

3. Operating System

An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs. An operating system (OS), in its most general sense, is software that allows a user to run other applications on a computing device. While it is possible for a software application to interface directly with hardware, the vast majority of applications are written for an OS, which allows them to take advantage of common libraries and not worry about specific hardware details. The operating system manages a computer's hardware resources, including: Input devices such as a keyboard and mouse. Output devices such as display monitors, printers and scanners. Network devices such as modems, routers and network connections. Storage devices such as internal and external drives. The OS also provides services to facilitate the efficient execution and management of, and memory allocations for, any additional installed software application programs. Memory management refers to management of Primary Memory or Main Memory. Main memory is a large array of words or bytes

where each word or byte has its own address. In a multiprogramming environment, the OS decides which process gets the processor when and for how much time. This function is called process scheduling. An Operating System manages device communication via their respective drivers. A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directions.

4. Architecture

It consists of Camera, Image Enhancement, Garbage detection, Location/GPS and sending Message/Mail to Municipal department for Location Detection. There are above 600 datasets for clean roads, garbage and small trash.

Firstly a photo of a garbage is taken by any one and then it is checked for the image enhancement and then identifies whether it is garbage or not and gives the output saying garbage detected, if it is the image of garbage. Finally the location of that particular garbage is detected and information is sent to the particular GHMC department.

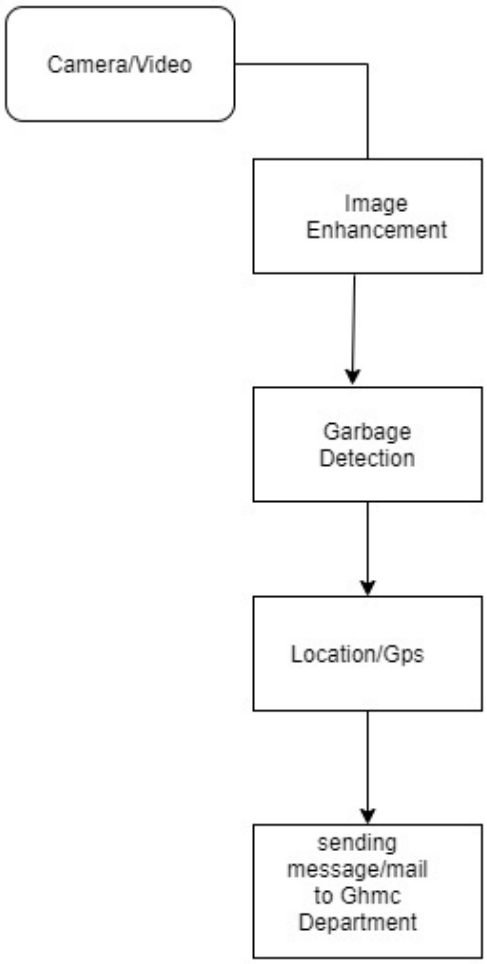


Fig 4.1: Archtecture

5. IMPLEMENTATION

IMPLEMENTATION

Working of the model

This is the software that helps the GHMC people to know where the garbage is present and to clear it and have a proper clean city.

- The Model is being trained with the help of Auto Edge ML (Firebase service).
- The Model is evaluated depending upon the threshold values of 2.
- The Model evaluation is given below in the model analysis.
- The application is run through the android phone.
- The image has been captured to detect the garbage.
- If the garbage is detected then Gps will be activated and the message will be sent through the mobile to the concerned department.

Model Analysis

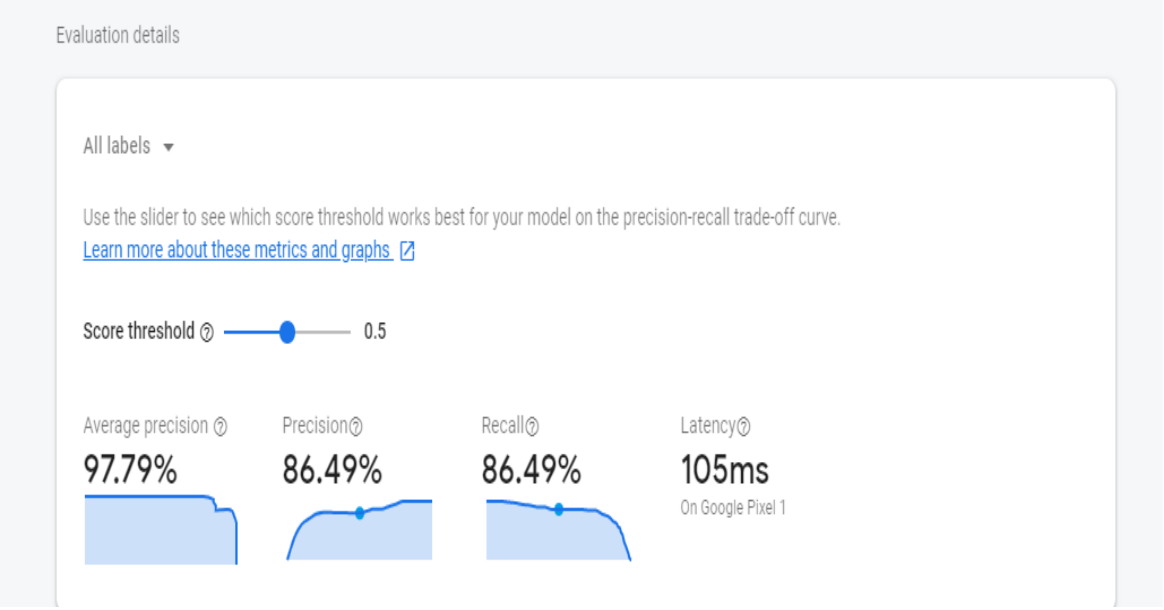


Fig 5.1 : evaluation for all labels

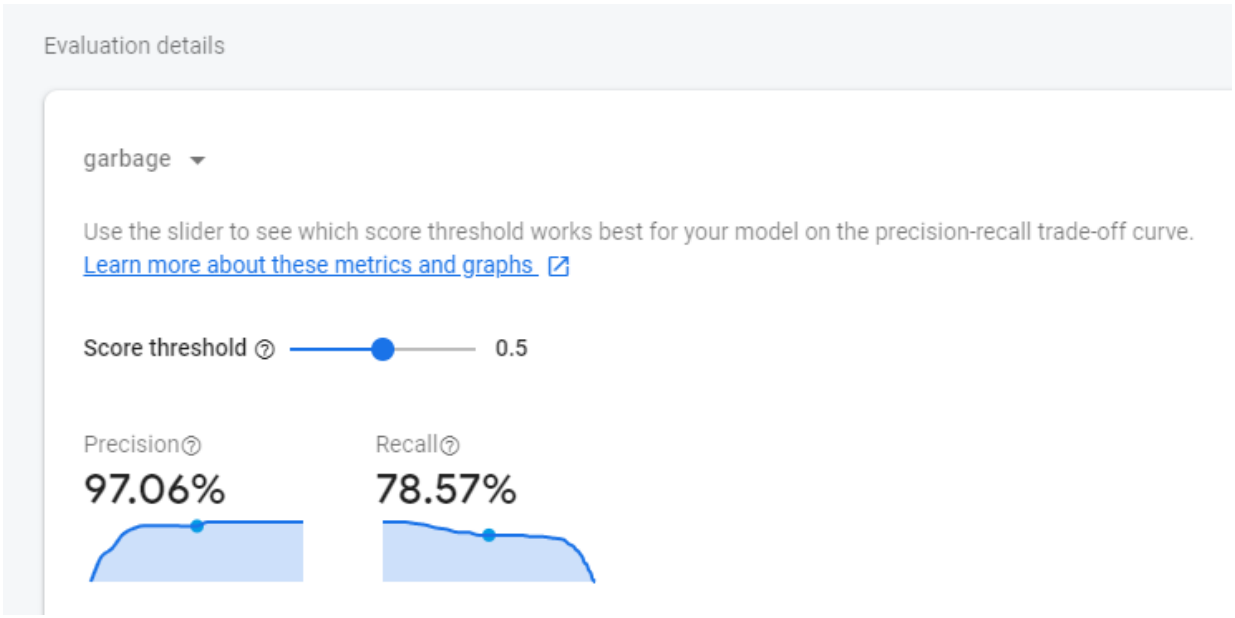


Fig 5.2 : Evaluation for Garbage labels

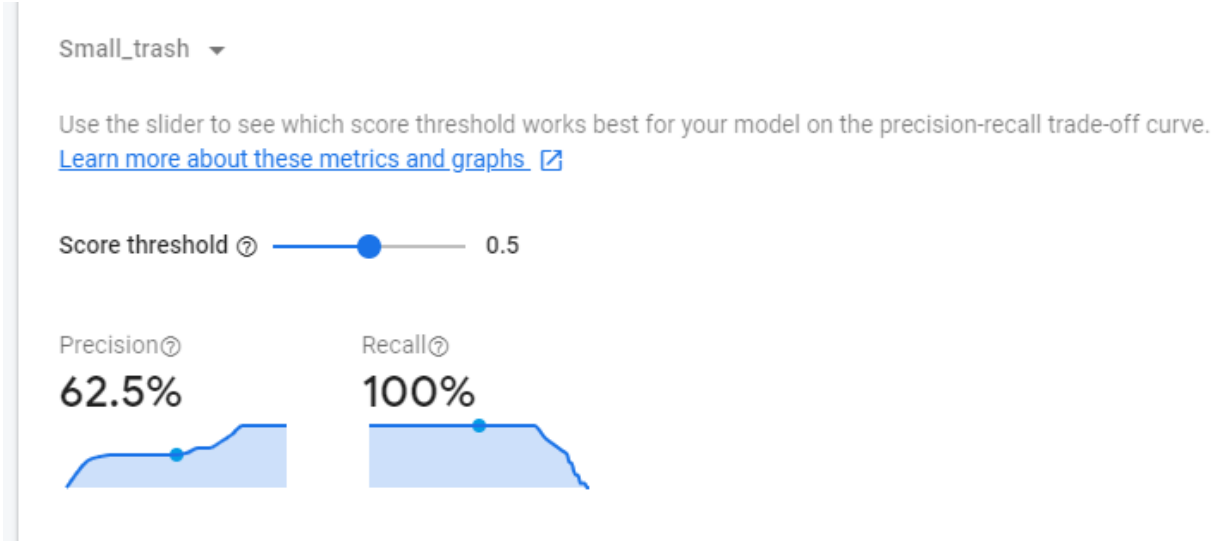


Fig 5.3 : Ealuation for Small Trash labels

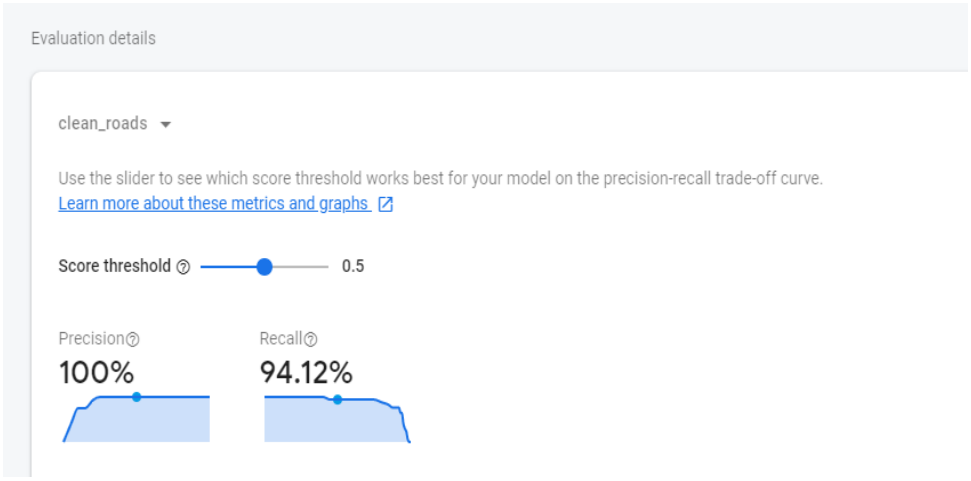


Fig 5.4 : evaluation for Clean Roads labels

Confusion Matrix

Fig 5.5: Confusion Matrix

Source Code

```
protected void onCreate(Bundle savedInstanceState)
 {
      super.onCreate(savedInstanceState);
 setContentView(R.layout.activity_main);
 cameraView = findViewById(R.id.cameraView);
    imageViewResult = findViewById(R.id.imageViewResult);
       textViewResult = findViewById(R.id.textViewResult);
  textViewResult.setMovementMethod(new ScrollingMovementMethod());
btnToggleCamera = findViewById(R.id.btnToggleCamera);
  btnDetectObject = findViewById(R.id.btnDetectObject);
     cameraView.addCameraKitListener(new CameraKitEventListener()
{
```

```
@Override          public void onEvent(CameraKitEvent cameraKitEvent)
{          }

 @Override          public void onError(CameraKitError cameraKitError)
{          }
@Override          public void onImage(CameraKitImage cameraKitImage)
{
        Bitmap bitmap = cameraKitImage.getBitmap();
bitmap = Bitmap.createScaledBitmap(bitmap, INPUT_SIZE, INPUT_SIZE, false);
        imageViewResult.setImageBitmap(bitmap);

final List<Classifier.Recognition> results = classifier.recognizeImage(bitmap);
      detect_value=results.get(0).toString();
   textViewResult.setText(detect_value);
  }
  @Override          public void onVideo(CameraKitVideo cameraKitVideo) {          }       });
    btnToggleCamera.setOnClickListener(new View.OnClickListener() {
    @Override          public void onClick(View v) {
          cameraView.toggleFacing();
             }       });
 btnDetectObject.setOnClickListener(new View.OnClickListener() {
       @Override          public void onClick(View v) {
    cameraView.captureImage();
   if (detect_value.contains("garbage")) {
Toast.makeText(getApplicationContext(),"Garbage
detected",Toast.LENGTH_LONG).show();
        Intent intent=new Intent(MainActivity.this,Main3Activity.class);
        startActivity(intent);
                }
```

```
            else
        Toast.makeText(getApplicationContext(),"Garbage not
        detected",Toast.LENGTH_LONG).show();
            }
          });

    initTensorFlowAndLoadModel();
}
```

Modules

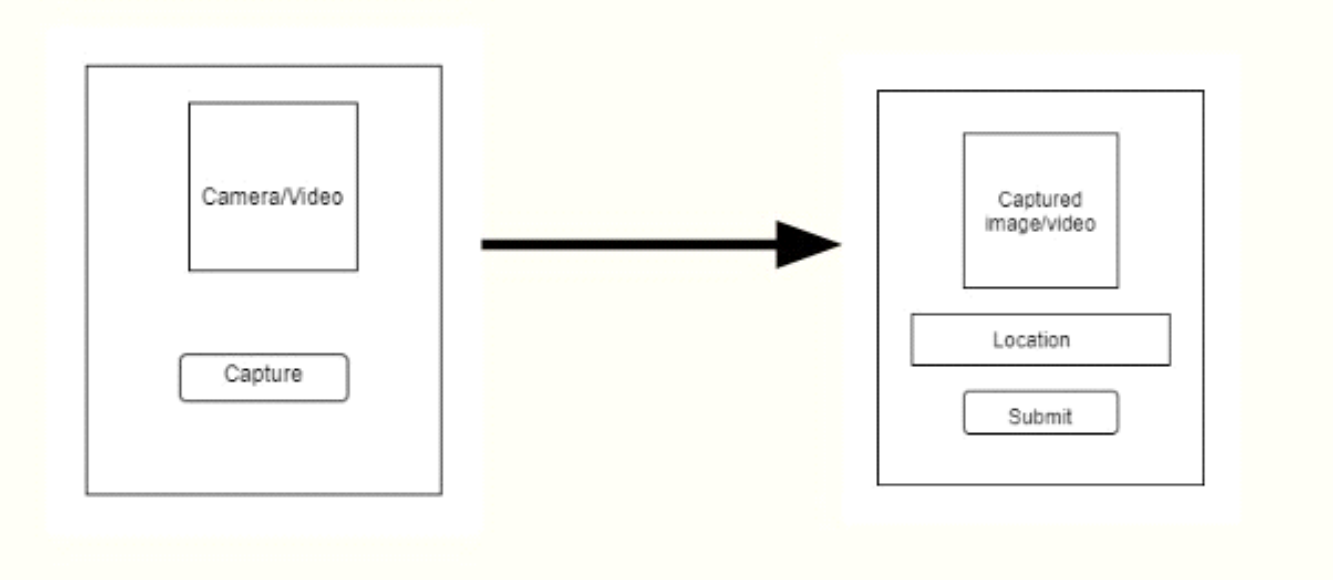


Fig 5.6: Modules

UML Diagrams

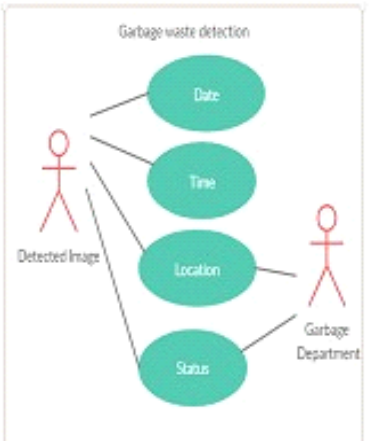
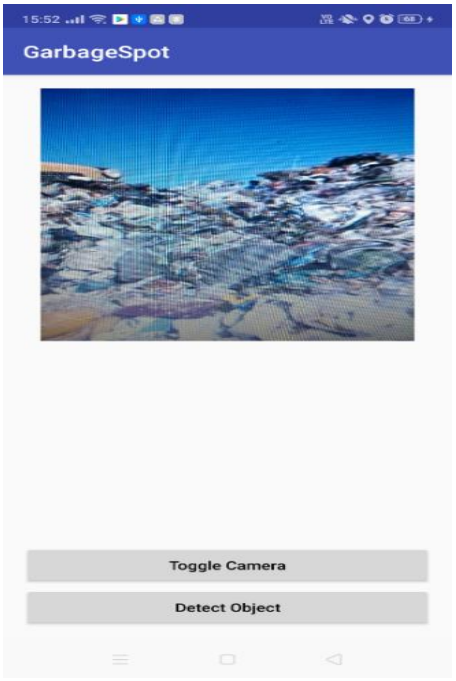
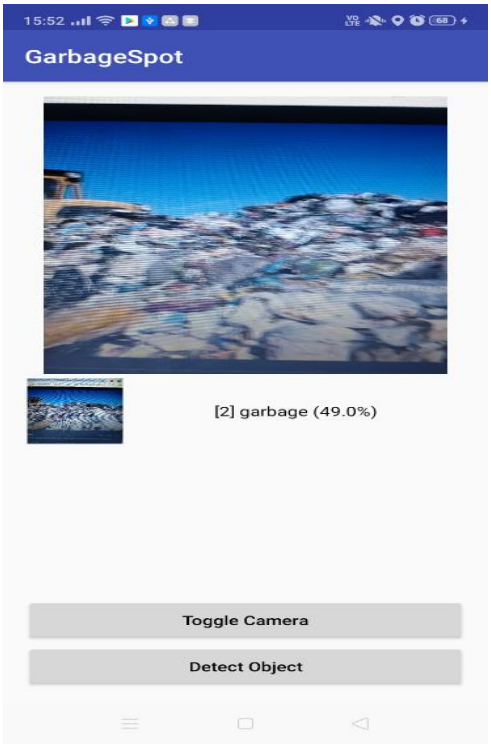
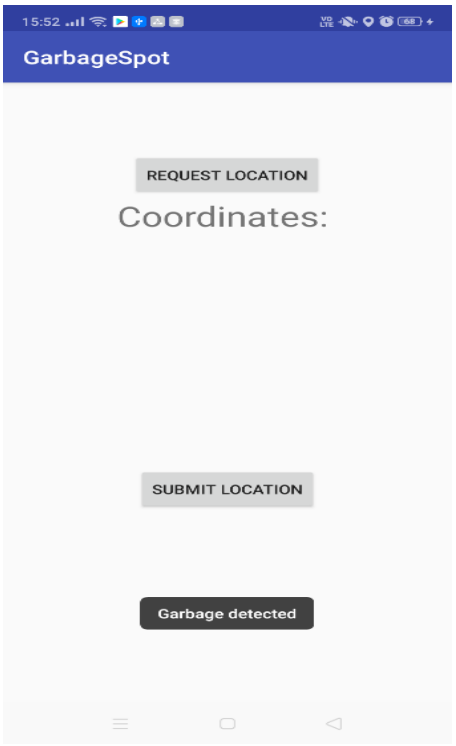


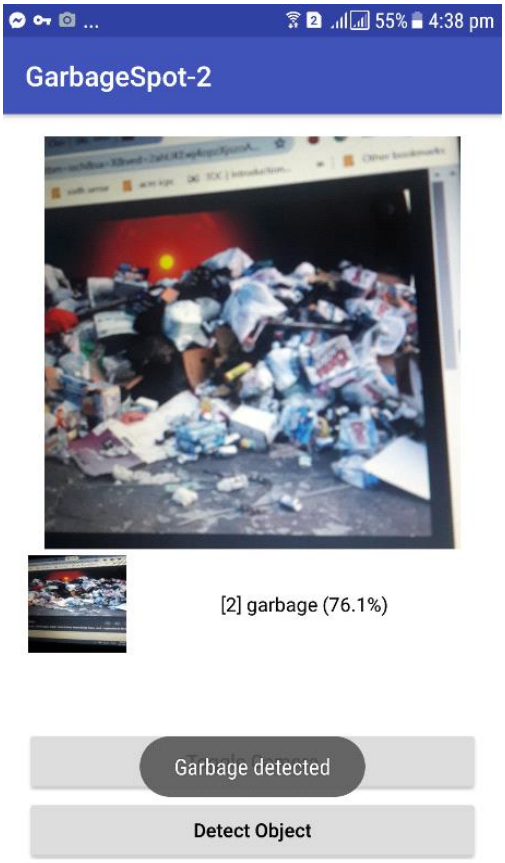
Fig 5.7: UML Diagram

Application









Figs 5.8: Application

The task of predicting what an image represents is called *image classification*. An image classification model is trained to recognize various classes of images. During training, an image classification model is fed images and their associated *labels*. Each label is the name of a distinct concept, or class, that the model will learn to recognize.

Given sufficient training data (often hundreds or thousands of images per label), an image classification model can learn to predict whether new images belong to any of the classes it has been trained on. This process of prediction is called *inference*.

Since the probabilities will always sum to 1, if the image is not confidently recognized as belonging to any of the classes the model was trained on you may see the probability distributed throughout the labels without any one value being significantly larger. he image classification models that we provide are useful for single-label classification, which means predicting which single label the image is most likely to represent. They are trained to recognize 1000 classes of image.

6. RESULT

Result

Model Result

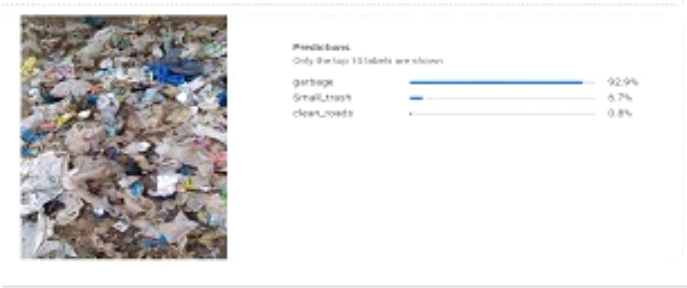
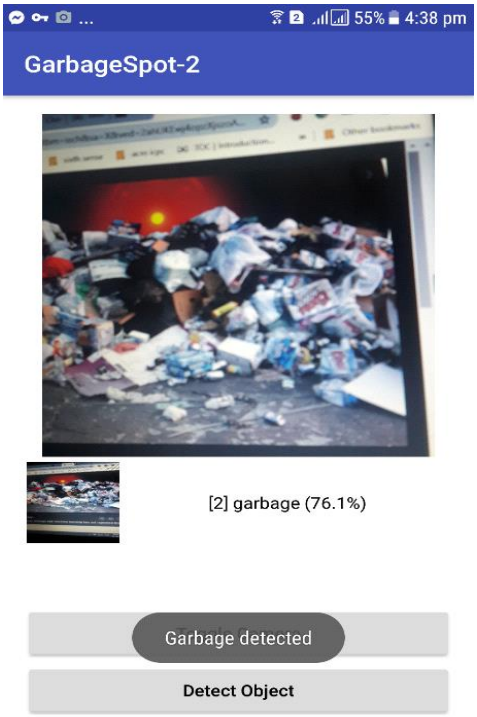


Fig 6.1: Model Result

The Model Result gives the from the model trained with the help of testing data set. The accuracy rate of the garbage detection is average 75-80%. There are three dataset values attributed as Garbage, Small Trash and Clean Road. The Model extracted from the Tensor-Flow lite. There are around 600-700 datasets used to train the model. From the given testing data model, we can see that the attribute has been detected with the accuracy of 92.9%. Urban garbage has extremely diversity in color texture and geometric form. For computer recognition, many things in urban scenes have characteristics similar to garbage, so misdetection happens. It is also observed that when these objects and garbage appear at the same time, false detection often occurs.

App Result



The application works on Android OS Mobile phone. We unified all image format into jpg and named them in consecutive numbers. Both the training picture and the test picture are placed in a named directory. The garbage dataset of this experiment contained 700 images, 500 among them were train images and 200 were test images. These images were photographed from different scenes and different directions, which could detect the diversity of images effectively. In addition, we used the data fusion strategy and per background class consists of at least 50 images.

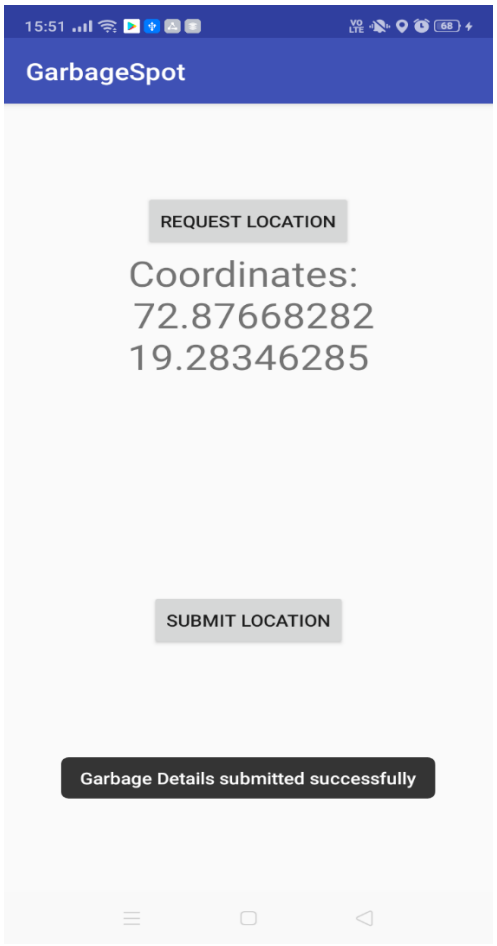
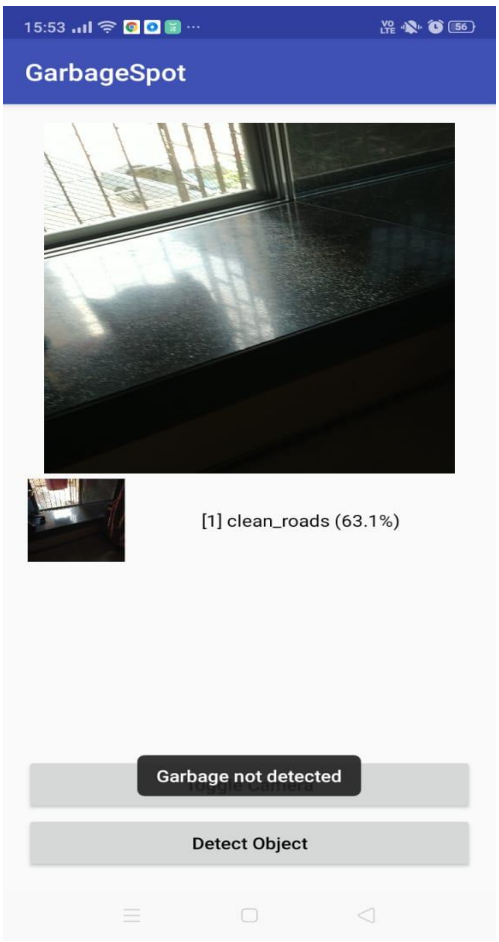
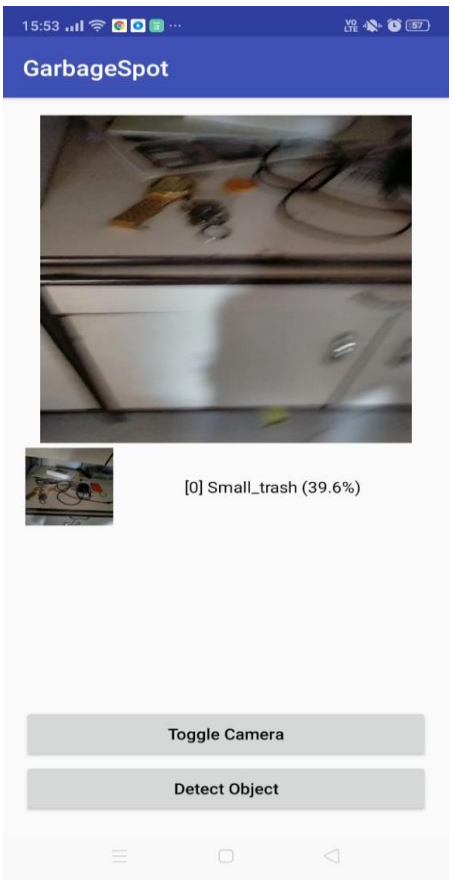


Fig 6.2: App Result

Modern applications for data analytics need to be accessible from any device and platform. Real-time data access requires the usage of an appropriate back-end technology and a properly designed data model able to support user queries. Our choice has fallen on Android- studio for the front-end development and on Google Firestore real-time database. The Location is been tracked with the help of Location API. Once the location is been detected we can send the data to the Firestore real-time database. This database acts as a major important part for storing data the garabage location.



Google Firebase allows us to store each GPS point as a nested collections/document store. The chosen data model allows us to quickly retrieve the list of detected trash points, with related GPS location, a count of containers/bags/cardboard, by zone and with hourly granularity. The support for distributed counters makes it easy to pre-calculate basic statistics by hour and zone in real-time with no need to perform complicated queries. The above image shows the true positive for clean roads. The sample image is take from the home where garbage is not there and we can say that there is an accuracy of 63%. This shows the confusion matrix value for the above label. It is important to show the correct detection with the help of better GPS module. The present module is based on u-blox neo-7 generation and neo-8 is available now, with improvements in precision. This will avoid the occasional "in the middle of a canal" detected points, due to poor satellite reception.



Of course, Google Maps is the chosen platform to show geo-analytics data. For the moment, support for two different visualization layer is present: heatmaps and markers. Heatmaps allow to have a quick glance at garbage distribution in areas, markers allow to inspect the details of the single garbage detection point. Firebase frees developers to focus crafting fantastic user experiences. You don’t need to manage servers. You don’t need to write APIs. Firebase is your server, your API and your datastore, all written so generically that you can modify it to suit most needs. Yeah, you’ll occasionally need to use other bits of the Google Cloud for your advanced applications. Firebase can’t be everything to everybody. But it gets pretty close. Real-time data is the way of the future. Nothing compares to it. Most databases require you to make HTTP calls to get and sync your data. Most databases give you data only when you ask for it.

7. CONCLUSION

CONCLUSION

Garbage detection is important part of smart and clean city. We can achieve the technology with the help of our project, Garbage detection using image processing. There are many ways to clean unknown garbage but this method would be proved as the beneficial for all the man-kind. This application is user friendly which makes ease to any sector of people. Garbage detection is important part of smart and clean city. We can achieve the technology with the help of our project, Garbage detection using image processing. There are many ways to clean unknown garbage but this method would be proved as the beneficial for all the man-kind. This application is user friendly which makes ease to any sector of people. This System will be helpful to make our surroundings neat and clean. With this system there would not be any spreading of diseases. Immediate interaction with the concerned department will help to make the roads and public places clean and green. Advance technology is been used for good purpose.

8. FUTURE WORK

FUTURE ENHANCEMENT

This System will be helpful to make our surrounding neat and clean. This System would help for not spreading diseases through the waste. Immediate interaction with the concern department will help to make the roads and public places clean and green. Advanced technology is been used for good purpose. This implementation of garbage detection system can help in maximum level of decrement of waste on roadside. It ultimately helps to keep the cleanliness in the society. My aim is to clear the waste of areas where the dustbins are not located. Keeping society clean can lead to decrement in the number of diseases. Our surroundings should be clean and neat that can be gained by using garbage detection system. Immediate interaction with the concerned department will help to make the roads and public places clean and green. Advance technology is been used for good purpose.

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