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Smart Doorbell Using Esp32 Cam/Esp-Eye and Blynk with Object Recognition Using Yolo Algorithm

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Abstract:- Nowadays one of the things we need to provide strong security is our home, especially if there is more safety risk in your area. in this paper, we developed a smart doorbell that can automatically notify your device when someone is at the door. Using ESP32 camera and Yolo algorithm you be able to see the person and detect objects outside the house, using Blynk application you can create a QR code to share with someone and your family to give them access to your doorbell system, and the smart doorbell will not work when there is no electricity or no power supply, to solve this problem we installed it with a solar panel that is directly connected to the power bank to keep the smart doorbell working even without electricity at the outlet.

Keywords:- *Smart Doorbell, Esp-32 Cam, Object Detection.*

I. INTRODUCTION

Doorbells have evolved from simple knocking devices to high-tech. It was simple at first. Someone let you into their home after a few raps on the door with your knuckles. When that wasn't loud enough because houses got bigger (and the world got louder both inside and outside), the doorknocker was invented. The doorknocker, which could be as simple as an iron ring or as elaborate as a work of art, has been in use for centuries.

Traditional doorbells do not allow a homeowner to remotely engage with those who come to their door, preventing communication with visitors or deliverers and jeopardizing the home's security. Venkata NRupa CDharmika B et al (2021).

Doorbells have long been used to keep people safe. Since the invention of modern homes, they have been secure. This need is even greater for those who have a disability that prevents them from meeting the visitor. To provide a solution in this regard, this paper proposes a smart model that performs the function of a doorbell, by alerting the user. Lu SWang BWang H et al (2019).

The proposed system helps in adapting traditional doorbell methods to enhanced security methods. The suggested system consists of a camera sensor known as esp32-cam to capture the person who presses the doorbell button and store images of people. Through the Blynk application, you can see the person who is standing outside. When someone presses the buzzer button, multiple people can be notified.

II. REVIEW OF RELATED LITERATURE

This chapter documents the studies about Smart doorbell and the technologies and hardware that are used by developers to create smart doorbell.

A. Study about Smart Doorbell

According to Kavitha, Kayiram. (2019). Smart Surveillance with Smart Doorbell. IJITEE (International Journal of Information Technology and Electrical Engineering). 8. Home Security has become an important concept in the modern era. Our Smart Doorbell can alert the resident automatically with an alarm when there is a visitor at the door. As we witness a huge transformation in technology, the world is emerging smart in every aspect. These smart devices are invading into our lives, while offering the required privacy. The Internet-of-Things (IoT) devices remotely monitor objects connected by Internet. In this paper, we have developed a smart doorbell that can alert the residents when it detects human presence and triggers the doorbell to notify its residents and also can send the data to the cloud or any storage devices spontaneously. The smart doorbell developed will have PIR or ultrasonic (passive infrared) sensor that detects the presence of humans over a given distance and can capture the picture of the object near the door. Further, this picture is e-mailed to the registered e-mail and also pushed to cloud as well offering the required privacy.

B. Study about Object Detection

A. Ćorović, V. Ilić, S. Đurić, M. Marijan and B. Pavković, "The Real-Time Detection of Traffic Participants Using YOLO Algorithm," 2018 26th Telecommunications Forum (TELFOR), 2018, pp. 1-4, doi: 10.1109/TELFOR.2018.8611986.Abstract: Object detection is one of the key software components in the next generation of autonomous cars. Classical computer vision and machine learning approaches for object detection usually suffer from the slow response time. Modern algorithms and architectures based on artificial neural networks, such as YOLO (You Only Look Once) algorithm, solve this problem without precision losses. In this paper we provide the demonstration of the usage of the newest YOLOv3 algorithm for the detection of traffic participants. We have trained the network for 5 object classes (car, truck, pedestrian, traffic signs, and lights) and

have demonstrated the effectiveness of the approach in the variety of the driving conditions (bright and overcast sky, snow, fog, and night).

C. Study about Google Apps Script

Radenković, Maša & Tubić, Anđela & Stojanović, Vesna & Petrovic, Nenad & Nejkovic, Valentina. (2021). Adopting Google Apps Script for Development of Fitness Applications for Different Purposes. As the number of G Suite services increases, Google's cloud-based scripting platform Apps Script is becoming more and more popular. It enables convenient data connectivity and exchange between different services within G Suite platform. In this paper, it is shown how Google Apps Script can be adopted for quick and easy development of applications for different purposes. As proof-of-concept, three case studies from fitness domain are presented: personalized fitness trainer multiplatform mobile application, application for automated generation of nutrition plan and automated generation of trainings for runners.

D. Study about ESP-32 Camera

Babiuch, Marek & Postulka, Jiri. (2020). Smart Home Monitoring System Using ESP32 Microcontrollers. 10.5772/intechopen.94589. This chapter deals with the implementation of our own monitoring system with home security. The system is designed using IoT modules and uses ESP32 microcontrollers. The chapter describes the design of the system, its hardware components, software implementation, security solutions, communication, the collecting and monitoring of processed data, as well as the quantification of costs for the production and deployment of this system. The proposed system secures a house by detecting an intruder in the building, triggering an alarm and capturing it all with camera images, and then sending data to the owner's smart mobile phone. The secondary task of the system is to collect data from sensors for monitoring the temperature of an object and presenting it via a web server.

E. Study about Algorithm

Xianbao, Cheng & Guihua, Qiu & Yu, Jiang & Zhaomin, Zhu. (2021). An improved small object detection method based on Yolo V3. Pattern Analysis and Applications. 24. 10.1007/s10044-021-00989-7. In this paper, an improved algorithm based on Yolo V3 is proposed, which can effectively improve the accuracy of small target detection. First of all, the feature map acquisition network is improved. The image double-segmentation and bilinear upsampling network are used to replace the 2-step downsampling convolution network in the original network architecture, and the feature values of large and small objects are amplified. Secondly, a size recognition module is added to the input image to reduce the loss of morpheme features caused by no-feature value filling and enhance the recognition ability of small objects. Thirdly, in order to avoid the gradient fading of the network, the residual network element of the output network layer is added to enhance the feature channel of small object detection. Compared with Yolo V3, our algorithm improves the detection accuracy of small objects from 82.4 to 88.5%, the recall rate from 84.6 to 91.3%, and the average accuracy from 95.5 to 97.3%, respectively.

F. Study about Blynk Application

Anjali Shrivastav (2021). Automation of device has a wide scope for this generation as well as in forthcoming generation. In this mobile communication technology is playing a major role in the world of automation. This articles is fully based on low cost and reliable home control monitoring system for accessing and controlling devices and appliances remotely using Android based smart phone application. while using this technology the system improves the living standard at home, reduce human effort, energy efficient and time saving and thus make a smart home. And also it is very helpful for providing support to disable people and fulfill their needs in home and thus they lead a normal life. This propose system consists of Android mobile in using ESP32 with Blynk app, IR remote & Manual control relays. We are a using Wi-Fi technology to monitor the device because of its accuracy, high range and instant connectivity. This module controls the home appliances with a very ease of installation and it is user friendly.

III. METHODOLOGY

The methodology used by developers to conduct the research was determined in this chapter. This chapter describes the research design, the target client, and the system's operation and completion.

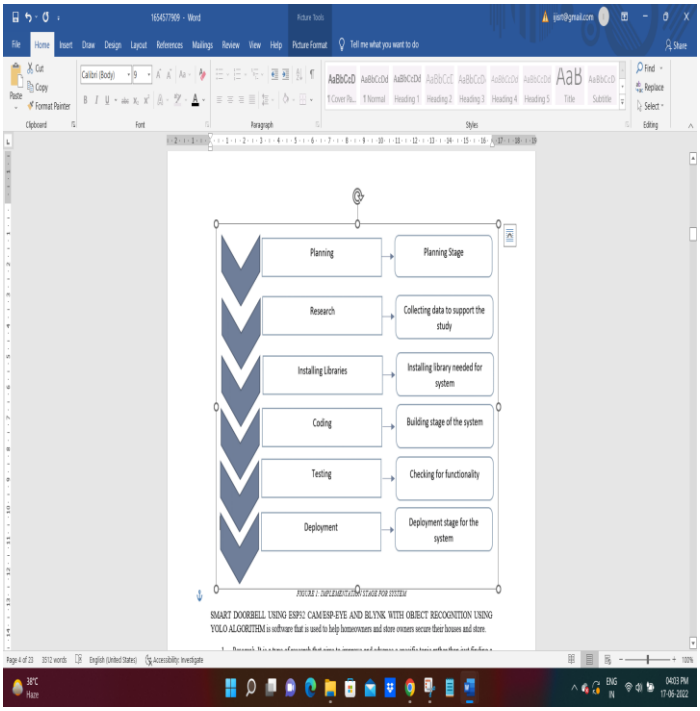

Fig 1: Implementation Stage For System

SMART DOORBELL USING ESP32 CAM/ESP-EYE AND BLYNK WITH OBJECT RECOGNITION USING YOLO ALGORITHM is software that is used to help homeowners and store owners secure their houses and store.

1. *Research*. It is a type of research that aims to improve and advance a specific topic rather than just finding a solution to a specific problem.

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2. *Software*. Used in development, developers used C++ and HTML for frontend development while in the backend developers used Java script, Developers also used Yolo Algorithm for object recognition and Arduino IDE for an integrated development environment.
3. *System Flowchart*

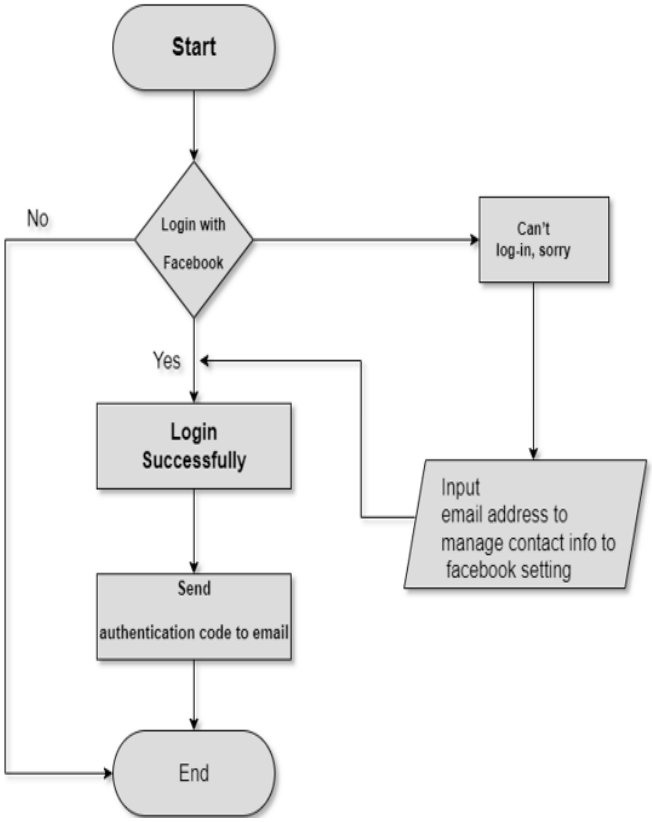

Fig 2: Blynk Application Login Flowchart

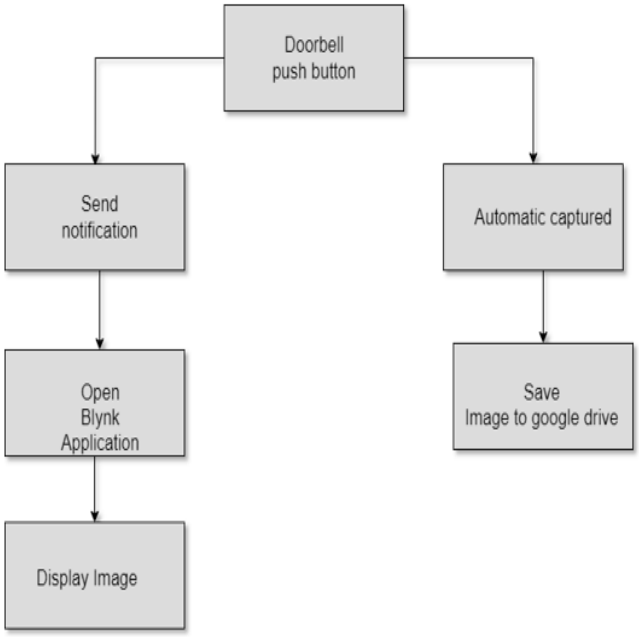

Fig 3: Smart Doorbell Flowchart

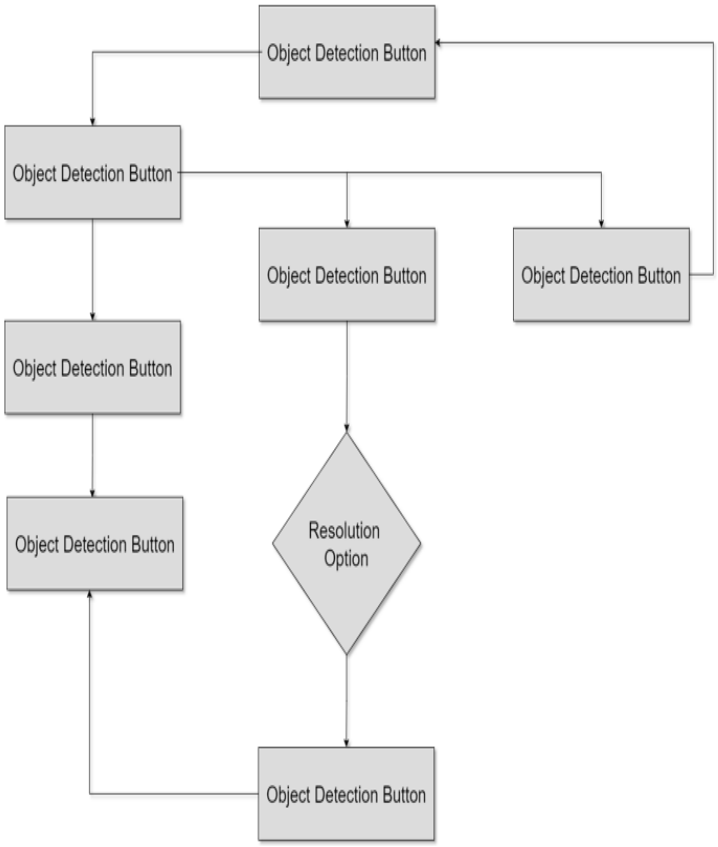

Fig 4: Object Detection Flowchart

The diagram above shows how the system runs. The steps for using the system are shown below.

Step 1. Log in using a Facebook account to Blynk Application. A user needs to add an email address to manage contact info in Facebook settings.
Step 2. Sign in. After adding an email address to manage contact info in Facebook settings, the user can now sign in.

➢ *System list features*

- *QR code* - serves as a pass to access the User interface of the Blynk app and google drive where the images are saved and you be able to receive notifications.
- *Receive notification* - It shows the Pop-Up Notification when someone Presses the Doorbell button.
- *Automatic captured* – When someone presses the button.
- *Save Image* - When the camera is captured, it is automatically saved to Google Drive.
- *Real-Time object detection* - detect person and kind of object that shows in the camera.

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IV. RESULTS AND DISCUSSION

This chapter shows some of the functionality, maintainability, speed, and accuracy of the system and its results.

A. The results of a phase of a study

a. Smart Door Bell using ESP32 Camera

Developers used the ESP32 camera to use for Automatic capture and Object Detection and Arduino IDE for setting tools and uploading data to the ESP32 camera, for automatically capturing the process almost takes 1 to 3 seconds before taking the image and saving the image to google drive.

i.Interfacing ESP32 Cam with USB to TTL/FTDI Converter

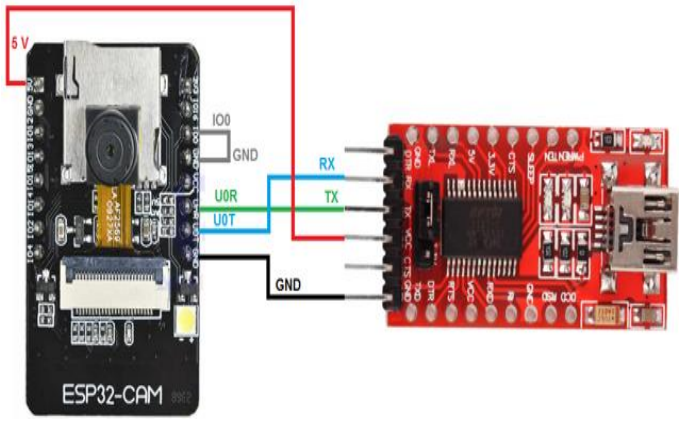

Fig 5: Connection Diagram

It shows the wiring diagram; Esp-32 camera connect to TTL Converter.

ii.Arduino IDE Tools Setup

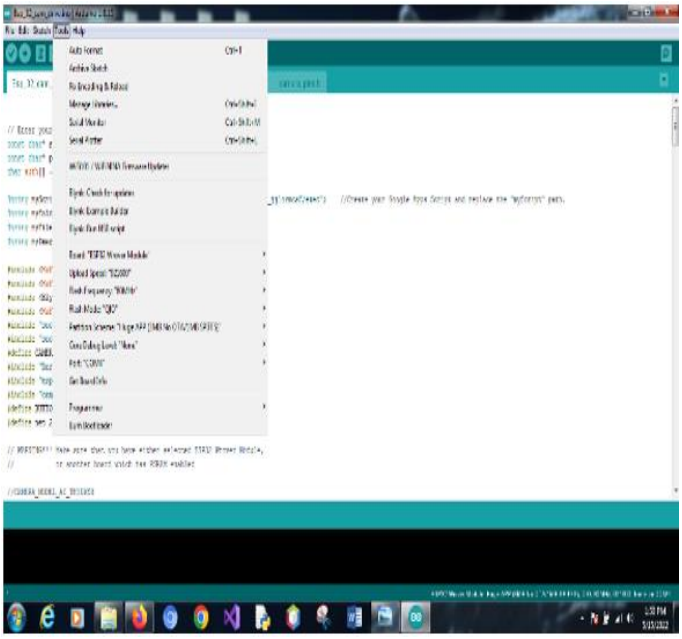

Fig 6: Tools Setup

It shows the set up tool settings for Esp-32 camera before uploading the codes.

iii.Processing Data

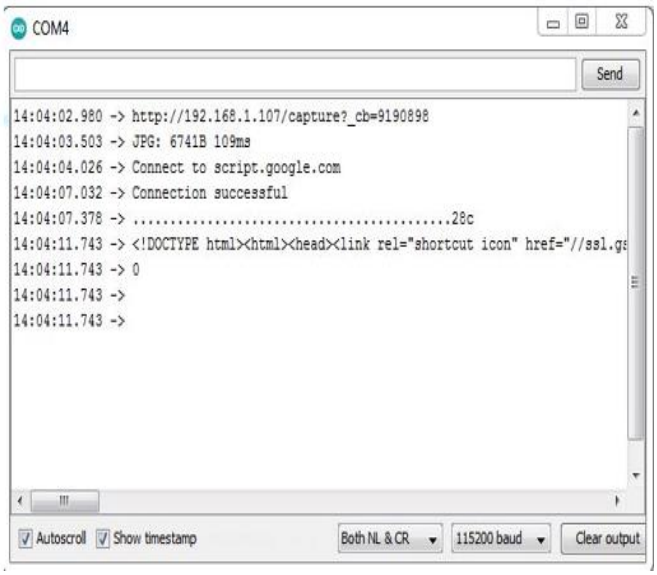

Fig 7: Connect to Script

After uploading the codes, the process shows to serial monitor before the Esp32 camera ready.

iv. Receive Notification Result

Fig 8: Receive Notification

It shows the pop-u notification above when someone presses the doorbell.

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v. Automatic Captured Result

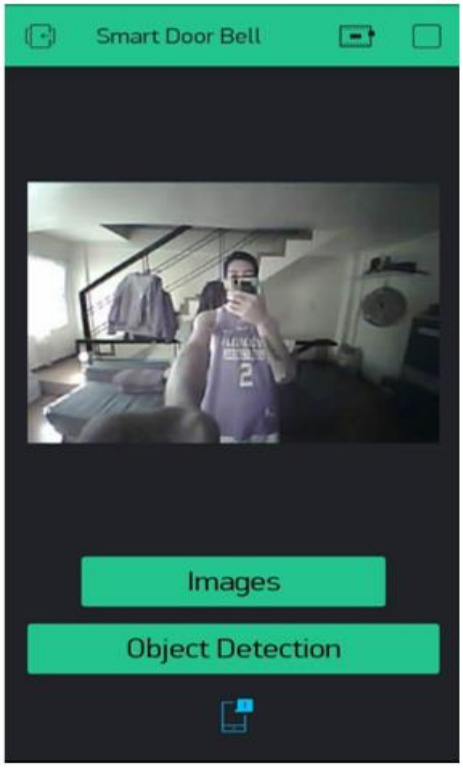

Fig 9: Automatic Captured

When someone pressed the doorbell button the camera automatically captured .

vi.Save Image Result

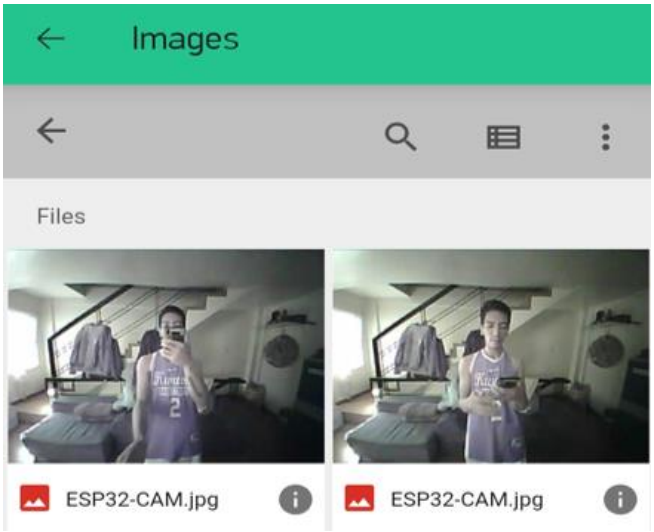

Fig 10: Google Drive

It shows the image automatically save to google drive.

Object Recognition

Yolo was used by the developers to detect person and kind of object that shows in the camera, for object detection the process almost takes 10 to 15 seconds before the camera is ready to detect.

vii.Loading Model Processing for Detection

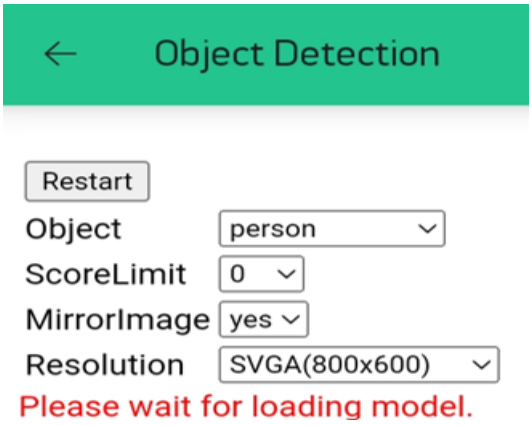

Fig 11: ESP32 Camera Processing

It shows the loading model before the start detect button is ready.

viii.ESP32 Camera Ready

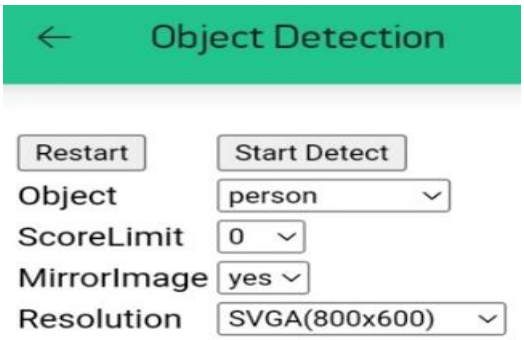

Fig 12: Camera Ready Result

It shows start detect button is ready.

ix.Start Detect Result

Fig 13: Detection Result

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After starting detect button, the camera will start to name and identify the objects.

B. Testing and Evaluation of the System

x.Maintainability

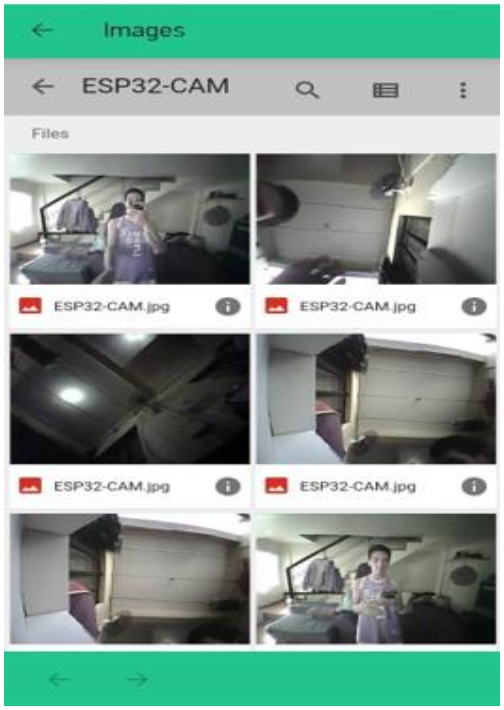

Fig 14: System Saving Image

It maintains the image saving using the database when someone presses the doorbell button.

xi.Functionality

```
void capture()
{
  uint32_t number = random(40000000);
  Blynk.notify("Someone is at the door..");
  Serial.println("http://"+my_Local_IP+"/capture?_cb="+ (String)number);
  Blynk.setProperty(V1, "urls", "http://"+my_Local_IP+"/capture?_cb="+(String)number);
  delay(1000);
  SendCapturedImage();
  delay(500);
}

String Data = myFoldername+myFilename+myImage;

    client_tcp.println("POST " + myScript + " HTTP/1.1");
    client_tcp.println("Host: " + String(myDomain));
    client_tcp.println("Content-Length: " + String(Data.length()+imageFile.length()));
    client_tcp.println("Content-Type: application/x-www-form-urlencoded");
    client_tcp.println("Connection: keep-alive");
    client_tcp.println();

    client_tcp.print(Data);
    int Index;
    for (Index = 0; Index < imageFile.length(); Index = Index+1000) {
      client_tcp.print(imageFile.substring(Index, Index+1000));
```

Fig 15: Blynk Notify, set property and Wi-Fi client secure library

Developers used Blynk notify and set properly to connect blynk apps to doorbell and Wi-Fi client secure for saving the images to google drive.

```
const x = Predictions[i].bbox[0];
        const y = Predictions[i].bbox[1];
        const width = Predictions[i].bbox[2];
        const height = Predictions[i].bbox[3];
        context.lineWidth = Math.round(s/200);
        context.strokeStyle = "#00FFFF";
        context.beginPath();
        context.rect(x, y, width, height);
        context.stroke();
        context.lineWidth = "2";
        context.fillStyle = "red";
        context.font = Math.round(s/30) + "px Arial";
        context.fillText(Predictions[i].class, x, y);
```

Fig 16: Context makes boxes and names

Developers used the context function for object detection to display the box and name detected by the camera.

xii.Reliability

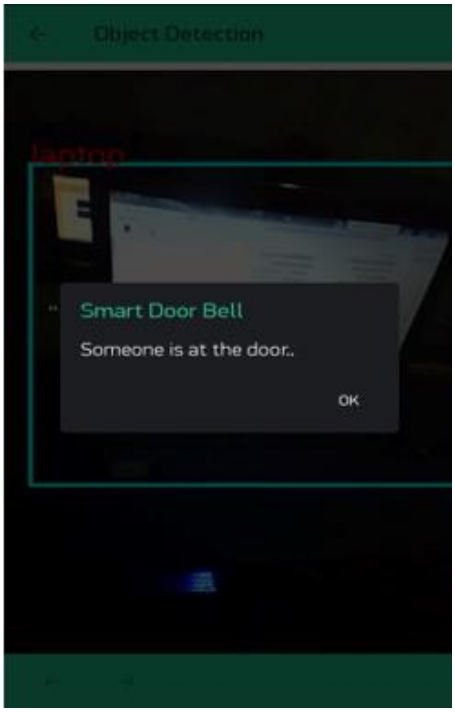

Fig 17: Object detection during receiving notification

It shows even if the camera detects it will still receive the notification, automatically captured and saved to google drive.

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xiii.Accuracy

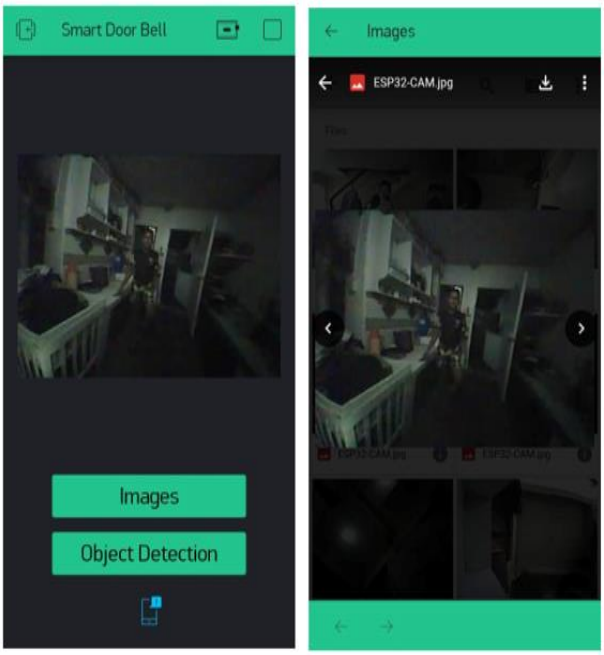


Fig 18: Sample data accuracy

In the image above, what image is captured by the camera is also the image that can be saved to google drive.

xiv.Speed

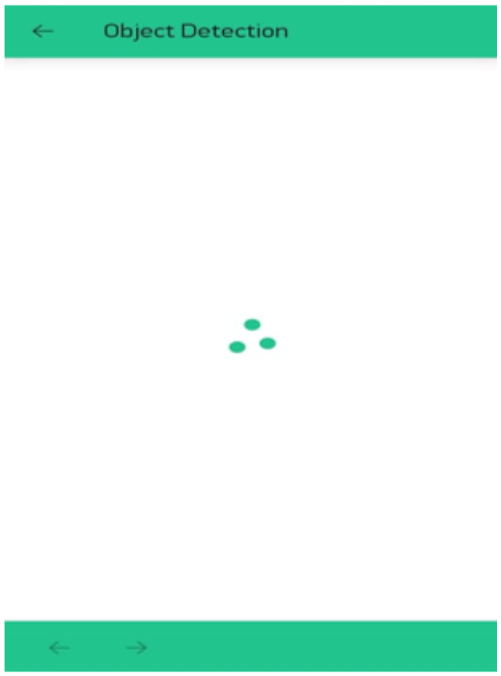


Fig 19: System functionality speed

In image above show the respond speed of object detection button.

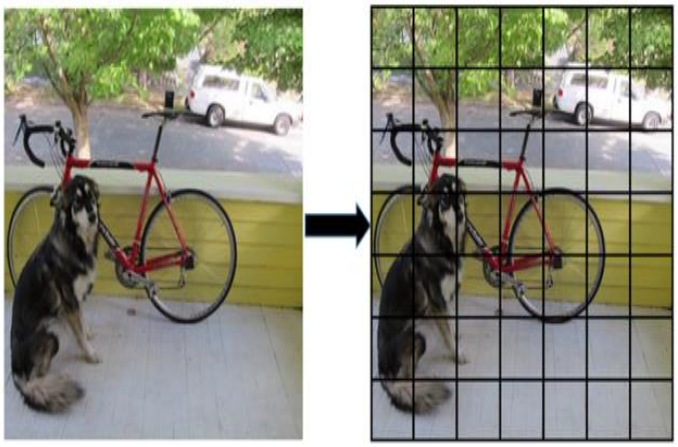
C. Testing and Evaluation of the Algorithm

xv.Functionality

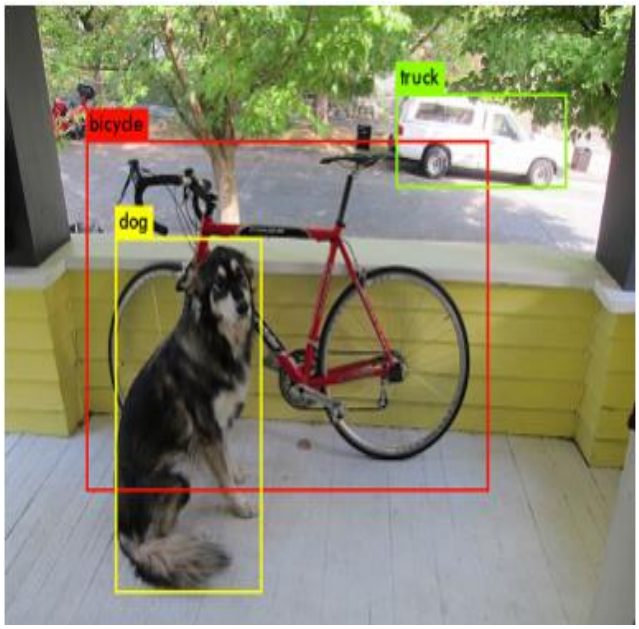
Sample Yolo Algorithm Functionality

YOLO is a real-time object identification technique that uses neural networks. This algorithm is well-known for its speed and accuracy.

- The image is separated into various grids



- In image classifier would classify the sub-picture within the bounding box,



xvi.Accuracy

Sample YOLO algorithm accuracy

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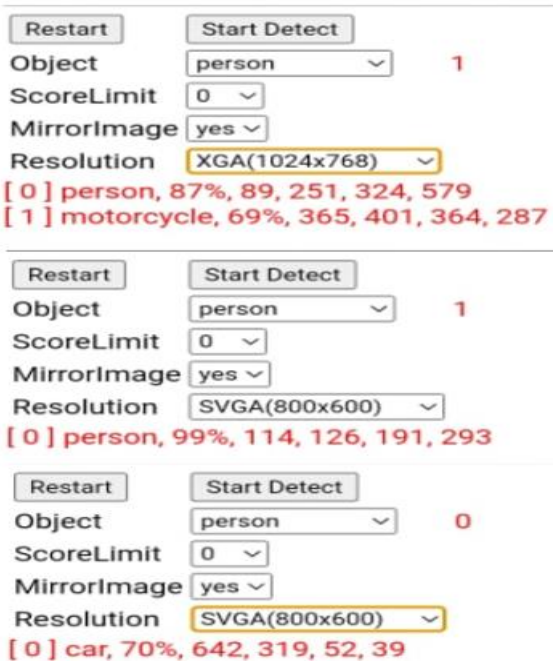

Fig 20: Yolo algorithm accuracy

It shows the estimated percentage accuracy of the yolo algorithm based on what detecting by the Esp-32 camera.

xvii.Speed

4.3.3.1 Sample Yolo algorithm speed

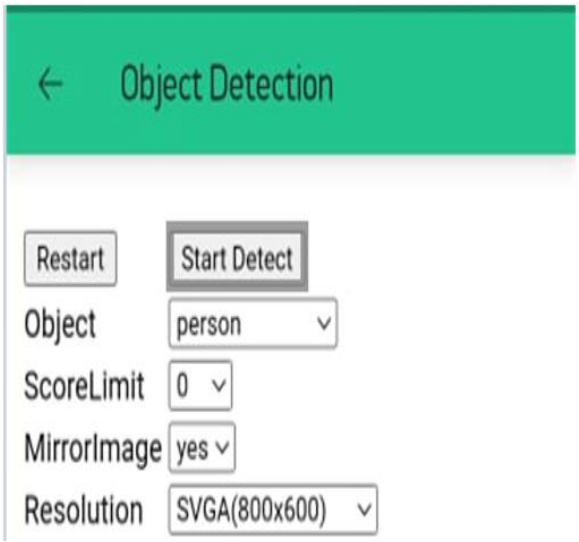

Fig 21: Yolo algorithm speed

It shows the YOLO algorithm speed after clicking the start detect button YOLO algorithm starts in less than 3 seconds.

V. CONCLUSION AND RECOMMENDATION

This chapter concludes the study by dealing with conclusions and recommendations of Smart Doorbell using Esp32-cam with Object Detection for homeowners and store owners. The research was done entirely online. Homeowners and Store owners were chosen as the respondents.

➢ *Conclusions*

Nowadays there are many types of smart doorbells on the market, the problem here is that they are too expensive so other residents can't afford the product. Findings revealed that 19% of respondents don't have a smart doorbell. The market price is more expensive it ranges from 9,194php compared to what we created the cost estimated is 2,500php only. The Esp 32 camera is a cheap and high-quality camera for creating smart doorbells. By doing so, we share the benefits of smart doorbells to home users and help to make the world a safer and better place through technology.

➢ *Recommendations*

After a thorough assessment and considering the foregoing finding and the conclusion of the study, the following recommendations are presented:

1. For programmers and developers, it is ideal to make other important features easy to understand for those who are difficult to understand when it comes to technology so that it is not difficult for others to choose and understand the capabilities of the smart doorbell.
2. For new users, it is advisable to take the time to read the manual guide to prevent misuse of the smart doorbell, and it is advisable to examine the possible reason for breaking the doorbell to prevent it, especially when mounting the doorbell. if it is waterproof or easily removed from the wall on which it is mounted.

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