A Project Report

on

Social Distancing Detector

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

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Under The Supervision of
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CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the project, entitled "**AI POWERED TURRET SYSTEM**" in partial fulfillment of the requirements for the award of the **BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING** submitted in the **School of Computing Science and Engineering** of Galgotias University, Greater Noida, is an original work carried out during the period of **JULY-2021 to DECEMBER-2021**, under the supervision of **Dr. Pallavi Jain** of School of Computing Science and Engineering, Galgotias University, Greater Noida.

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Supervisor

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CERTIFICATE

The Final Thesis/Project/ Dissertation Viva-Voce examination of **19SCSE1010569 RAJAT SRIVASTAVA, 19SCSE1010370 – SAHIL MISHRA** has been held on_____and his/her work is recommended for the award of BACHELOR **OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING.**

Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Project Coordinator **Signature of Dean**

Date:

Place:

ABSTRACT

iOT and AI technology are playing a very important role in today's world, but as we know iOT and AI have many advantages and also has some disadvantages. Defense system, home security, agriculture and many more implementations are available in our day to day lives.

The Defense system or Agriculture can be greatly benefited if we could automate manual work using iOT and AI; Lives of soldiers andalso huge amount of time of peasants and labor work could be reduced drastically with the help of this system. iOT and AI is being already used in today's defense as well as irrigation system.

We already have such systems available but the idea here is to reducethe costing of the project and also make it easily accessible and also increase the ease of use and maintenance. Moreover, use of this system already has its own advantage in defense as well as in irrigation system. We will focus on the defense side of the application, where we will use an AI powered computer system to guide, aim and fire a gun through a robotic turret system. The systemcan be mounted and deployed in sensitive areas where manual guarding is hard and number of infiltration cases is high.

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Acronyms

CNN	Convolution Neural Network
R-CNN	Region Based Convolution Neural Network
FAST R-CNN	Fast Region Based Convolution Neural Network
FASTER R-CNN	Faster Region Based Convolution Neural Network
YOLO	You Only Look Once
HOG	Histogram of Oriented Gradients
SSD	Single Shot Detector
SPP	Spatial pyramid pooling
R - FCN	Region – based fully convolutional network

CHAPTER-1

Introduction

1.1 Introduction

In 2007, the military of Israel, first developed a system to mount a gun on a system, known as sentry gun. The system remotely controlled, locate, aim and neutralized the enemy/target. The system since then kept on getting more efficient but, until now, is yet not much widely used by the defense forces aroundthe world. The problem with the entire system had been the non-reliability and high cost of production. In fact, the entire pro jet development cost crossed alittle over 4 million USD. The system was turret mounted with a 50-calibermachine gun.

The sentry gun system has many other implementations, including in fields of agriculture and irrigation. But such a high-cost system really makes it non- practical for a field that solely relies on low-cost methods at the roots of its functionality.

The sentry gun is simply based on iOT, where micro-controllers are used to drivemotors in various axis according to the commands sent by an operator in real time. The operator can operate the system remotely from the base, or bunker and use the turret system to neutralize enemies without ever getting into direct contact. The controlling system typically used joystick controller and a monitor screen which controls the movement of the turret and gives the feed from the mounted cameras respectively.

1.2 Object Detection

First of all, what's item recognition? Object Recognition is the time period which refers back to the imaginative and prescient of the pc or artificial version which identifies gadgets in virtual photographs. Image category entails distinguishing the magnificence of 1 item in a photograph. Object localization is regarding or figuring out one or extra gadgets in a photograph and making that photograph component stand out for identity through drawing containers across the images.

The three computer vision tasks:

1. Image classification
2. Object Localization
3. Object Detection

1.2.1 Image Classification-

It is predicting the which elegance or kind the item in a photograph falls into

1. Input- a virtual photograph is supplied with the item for detection, consisting of a picture of a person.
2. Output- A label is mapped to the photograph.

1.2.2 Object Localization –

The item with inside the photograph is positioned after which made to face out or diagnosed via way of means of creating a field round the item.

1. Input- a photograph is supplied with one or extra identifiable items, like a picture.
2. Output- one or extra bounding packing containers

1.2.3 Object detection –

It is finding the photos with the bounding field and the kinds of the items positioned with inside the photograph.

1. Input- An photograph which includes one or extra identifiable items.
2. Output- one or extra bounding packing containers and labels for every bounding field.

1.3 Serial Communication

Serial communication is a specialized technique that utilizes a couple of transmission lines to send and get information, and that information is constantly sent and gotten the slightest bit at a time. Since it takes into consideration associations with few transmission wires, one of its benefits is its capacity to hold down on wiring material and transferring gear costs.

For this particular project, we will use serial communication over USB(Universal Serial Bus). Needless to say the entire serial communication can well be done wireless-ly using wifi or using radio control. In the final product however, it is advisable to use fibre optic cable to communicate between the micro controller and the main computer as it will provide much faster data transfer speed and every millisecond matters in the particular use case. How ever for the sake of simplicity and prototyping we are using simple USB serial communication.

Now to actually communicate between the central computer and the micro controller, jSerialComm, an open source library is being used. There are various other libraries out there available but we found it to be working most efficiently with Java, which is our choice of language for this project. JserialComm transfers data in form of byte code. The data in our case is a formatted string which has the angular coordinates for the micro-controller to move the servo motors and use the angular movement for aiming. jSerialComm is a Java library intended to give a stage free method for getting to standard sequential ports without requiring outside libraries, local code, or some other apparatuses. It is implied as an option in contrast to RxTx and the (belittled) Java Communications API, without hardly lifting a finger of-utilization, an upgraded support for breaks, and the capacity to open different ports all the while.

1.4 Micro-controller

Micro-controller is the secondary brain of our system. The micro-controller receives data sent to it via serial communication and changes it into electronic signal to drive the servo motors. There are various micro-controller available out there. For our prototyping purpose, we are using Arduino UNO. Arduino Uno is a microcontroller board dependent on the ATmega328P. It has 14 computerized input/yield pins (of which 6 can be utilized as PWM yields), 6 simple sources of info, a 16 MHz artistic resonator (CSTCE16M0V53-R0), a USB association, a power jack, an ICSP header and a reset button. It contains everything expected to help the microcontroller; just interface it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin.. You can fiddle with your Uno without stressing a lot over accomplishing something off-base, most dire outcome imaginable you can trade the chip for a couple of dollars and begin once more.

For the final turret, custom built micro-controller can be used, especially designed and printed for the turret. This would not only cut down the cost of the system but would also make it over all more efficient.

1.5 Algorithm for Object Recognition:

Object Recognition is the term which refers to the vision of the computer or artificial modelwhich identifies objects in digital photographs

HOG (Histogram of orientated Gradients) feature Extractor and SVM (SupportVector Machine)

Before the age of deep learning, it absolutely was a progressive methodology for object detection.It takes bar graph descriptors of each positive (those pictures that contain objects) and negative (that image that doesn't contain objects) samples and trains our SVM model on it.

1.5.1 Bag of options model:

Alternatively, like a bag of phrases considers file as companion order less collection of phrases, this technique conjointly represents a photo as companion order less collection of photograph options. samples of this are SIFT, MSER, etc.

1.5.2 Viola-Jones algorithmic rule:

This set of rules is broadly used for face detection in the picture or length. It performs Haar-like characteristic extraction from the picture. This generates an oversized variety of alternatives. These alternatives are then surpassed right into a boosting classifier. This generates a cascade of the boosted classifier to carry out picture detection. An image should byskip to each of the classifiers to get a positive (face found) result. The gain of Viola-Jones is that it is a detection time of FPS which is probably applied in a length face reputation system.

1.5.3 You Look Only Once

YOLO is one of the algorithms for actual time item detection. YOLO is one of the maximum recognized or powerful algorithms for actual time item detection.

There are some one of a kind algorithm for item detection which may be essentially divided into:

1. Algorithms primarily based totally on regression: The algorithms primarily based totally on regression use instructions and bounding packing containers for the image. The pleasant recognized algorithms for this department are YOLO and SSD.
2. Algorithms primarily based totally on classification: These algorithms are a chunk slower than the earlier ones due to the fact they first select reputable areas after which they classify those areas the usage of CNN. Some of the widely recognized algorithms primarily based totally on classification.

Why pick out YOLO over different algorithms? YOLO is extra famous than different algorithms due to the fact it may attain extra accuracy even as additionally going for walks in actual time.

There are a lot of algorithms for object detection, to a name some of them are:

1. Fast R- CNN

2. Faster R- CNN

3. Histogram of oriented Gradients (HOG)

4. Region - based Convolutional Neural Networks (R- CNN)

5. Region - based Fully Convolutional Network (R - FCN)

6. Single Shot Detector (SSD)

7. Spatial Pyramid Pooling (SPP-net)

1.6 Open CV

OpenCV stands for OpenSource Computer Vision. OpenCV or OpenSource Computer Vision library holds an ocean of functions for Computer Vision. OpenCV or OpenSource Computer Vision incorporates greater than 2000 algorithms. The algorithms which might be found in OpenCV or OpenSource Computer Vision may be used to come across and apprehend one-of-a-kind gadgets which includes humans, their faces, hand gestures, actions etc. These algorithms may be used to song digital Digi-cam actions, produce 3d fashions of gadgets, discover pictures which might be comparable from a given dataset. With the assist of OpenCV it permits to study and write pictures, permits to seize videos, technique virtual pictures, carry out detection of features, come across gadgets which includes faces, eyes, cloth gadgets etc.

1.7 Jframe

We need a form load to run openCV on. Not only this, we need a form load to test various steps in the development process of the turret. In the initial stages, we are going to use Jframe to make start a window formload. The formload will be used as a mouse pad. The coordinates of the mouse pointer will be picked up using few of the various action handler available including mouse move, mouse drag to name a few. In more mature stages of the system. Window formload will be used to host the video feed data to work in sync with OpenCV and convert the position of target on the frame into coordinates. The coordinates generated using

either of the method are then converted into formatted string. The javax.swing.JFrame category is a type of container that inherits the java.awt.Frame category. JFrame works as a large window where components such as labels, buttons, text fields are added to create a GUI. Unlike the frame, JFrame has the option to hide or close the window with the help of setDefaultCloseOperation (int) method.

CHAPTER-2

Methodology

The proposed device enables guarding areas and location which have high risk of infiltration and guarding such locations is very difficult. It also can be used to guard areas, remotely or totally automatically. It also helps in cutting down manual forces and save human resources and precious lives of soldiers guarding locations. The proposed device makes use of opencv and jframe to pick the coordinates of the target in the frame of the video being feeded by a camera. The coordinates generated by opencv and jframe are then sent over to arduino via serial communication through jserialcomm. The data is then parsed by Arduino and then is used to control servo motors.

2.1 Network Video Recorder (NVR)

In this manner digital digicam video feeds from the Network Video Recorder (NVR) are streamed the usage of RTSP after which those frames are transformed to grayscale to enhance pace and accuracy and are ship to the version for similarly processing interior raspberry pi4. We have used the MobileNetV2 structure because the center version for detection as MobileNetV2 offers a massive value benefit compared to the everyday 2D CNN version. The manner additionally includes the SSD MultiBox Detector, a neural community structure that has already been skilled on a huge series of pics which includes ImageNet and PascalVOC for excessive exceptional photo classification.

2.2 Coordinates

Jframe is used to load a windows form load upon the execution of the software. The form load then is used to generate coordinates which either comes in either of the two ways-

Either, the coordinates of the mouse pointer are generated using the action handler of mouse move and mouse drag. This comes handy when the turret is needed to be used as a remotely controlled system, where it can be controlled by a computer mouse, like a fun video game.

Or, the coordinates of the target in the frame of the video feed are picked up by OpenCV. This is used when the turret is supposed to work entirely on its own, that is work automatically, detect and neutralize the target.

These coordinates are later converted into a formatted string and then parsed into byte value. Then the byte code is sent over to the micro-controller using serial communication.

2.3 Scaling Factor

The coordinates generated by the jframe from either of the above mentioned method, according to the need and scenario, the turret is supposed to function in, cannot be sent directly to the micro-controller. The reason for that is that, the value of the coordinates depends on the size of the jframe formload. For instance, if the jframe has a size of 1000x1000 pixels. And the coordinates generated by jframe/openCV are something like 560,480. When these coordinates are sent over to arduino, error occurs. Because the maximum angular rotation possible for a servo motor is 180 degree. That is, it's not possible to feed something 560,480 which has a maximam inout range of 180x180. For this reason we need a scaling factor. With the help of some basic mathematics, we can scale down coordinate of any point into arduino-server friendly range.

2.4 Real-time applications

The weapon system can be used in warzone or military sensitive areas where the cases of infiltration are very high. It can also help in bringing down the death of soldiers, by replacing them entirely or partially at the sight of installation of the system. It can be used in places where human patrolling is difficult, like in extreme weather conditions, etc. It can be used in fully automated mode, where the system automatically detects and neutralize the enemy, or infiltrator, or it can be controlled remotely from a safe place, or control room or maybe a bunker, where the entire turret is controlled using a mouse like in video games. Apart from defense/weapons, the system can also be used in agriculture field, where it can be used to automatically water the fields, or can be used to scare away animals or any predator by spraying a jet of water on them after automatically detecting them. The system can also be used as smart security camera where thecamera locks on the target and follows the target.

CHAPTER - 3

Literature Survey/Project Design

Internet of Things is nothing but an interrelated system of computer devices, micro-controller, motors, and other smart devices as such. It is widely used in all fields, including defense. The Sentry gun designed by the Israelis was solelybased on iOT technology. The system was neat and clean, but still had a huge room for improvements. Our project, just like the Sentry gun, would incorporate iOT as one of the technologies to bring the project into existence. The project will also use micro-controller (Arduino) to run the servos. The Arduino will be connected to the main CPU through serial communication. The flow of data and instruction in the current version will start with a window form load, built and manipulated using jframe library. The jframe will make an empty form load and will use various functions of its own to pick up mouse coordinated from the form load. It will also use function to sense mouse click the data created/picked up by the jframe will be used to control the turret and fire the gun. The mouse coordinated will be used for aiming and mouse click will be used to shoot. This entire data will be sent to the micro-controller via serial communication. In a future version of the project, this data will be createdusing a library called OpenCV. The library is based on face detection, which, we will use to detect the presence of anyone through a camera mounted along with the turret.The data to be sent to the micro-controller, is sent via serial communication, forwhich we are using a library called jserialcomm. The library is an open-source library, which allows us to send data through usb port at a custom baud rate (we are using 9600) in bytes form. An advancement could be using wireless system for communication.The data then is received by the micro-controller, in our case, Arduino. The data received by the Arduino is then passed through a scaling logic, which converts the data into angles, which are fed to the servos through the inbuilt function of the servo.h library in Arduino. The servos then aim the

turret. This cycle of sending, receiving, parsing and feeding to the servos is repeated every10 milliseconds or so, which in fact is the fresh rate of the entire system. Doing so prevents the servos to be overfed with information and work in an undesiredmanner.

In current years, item detection strategies the use of deep fashions are doubtlessly extra successful than shallow fashions in handling complicated duties and that they have performed incredible development in pc vision. Deep fashions for character detection attention on feature mastering contextual records mastering, and occlusion handling.

Deep mastering item detection fashions can now in particular be divided into families:

(i) two – stage detectors together with R-CNN, Fast R-CNN and Faster R-CNN and their versions

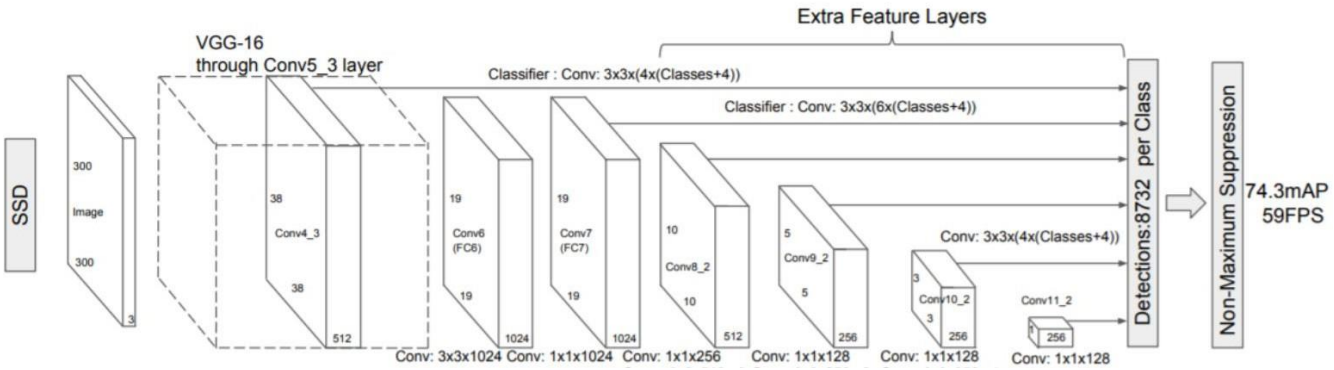
(ii) one - stage detectors together with YOLO and SSD. In -level detectors detection is executed in stages, with inside the first level, computed proposals and labeled with inside the 2nd level into item categories. However, a few methods, together with YOLO, SSD MultiBox, bear in mind detection as a regression trouble and examine the photo as soon as for detection.

In proposed machine we're the usage of Single Shot Detector MultiBox(SSD) which appears to be a great preference for real-time object detection and the accuracy trade-off is likewise very little. SSD makes use of the VGG-sixteen version pre-skilled on ImageNet as its simple version to extract beneficial photograph function. At the pinnacle of VGG16, SSD provides numerous convolutional function layers of reducing sizes.

3.1 SSD

SSD is a single-shot detector. It has no delegated area notion community and predicts the boundary bins and the lessons immediately from function maps in a single unmarried pass. To

enhance accuracy, SSD introduces: small convolutional filters to are expecting item lessons and offsets to default boundary bins.



3.2 Viola – Jones Object Detection System

The Viola – Jones item detection gadget may be educated to come across any item, however is specifically not unusual place for facial detection and is extra correct and faster. The Viola and Jones procedure is an instance of supervised learning. Zhu additionally shared every other very huge facial detection set of rules is a neural network-primarily based totally detector. Compared to OpenCV that is utilized in some of computed components, it's miles not able to solve the imbalanced workload issue skilled all through the implementation of the viola-jones face detection set of rules in GPUs. Glass et al. Addressed the significance of social differencing and the way the chance of pandemic increase may be slowly reduced via way of means of efficiently retaining social distance without the usage of vaccines or antiviral drugs.

3.3 Object Identification

The item identification, together with human identification, may be carried out via way of means of retraining the present deep getting to know fashions on a dataset such as humans in touch with surfaces or via way of means of developing limitations withinside the photograph itself and tracking breaches. Figure 1 indicates the laptop vision-primarily based totally AI approach for thedetection of social distancing. However, care needs to be taken to maintain privateness of humansbelow surveillance. These facts may be handed onto applicable employees who can fast get on- web website online and disinfect the surface. Emphasis on feasibility and effectiveness of growing robust, cost-effective, scalable systems, deployable withinside the health center surroundings without affecting different clinical gadgets wishes to be explored.

3.4 Other Statistics

According to statistics acquired with the aid of using the World Health Organization, the worldwide pandemic of COVID-19 has severely impacted the arena and has now inflamed greater than 8 million human beings worldwide. Wearing face mask and following secure social distancing are of the improved protection protocols want to be accompanied in public locations in an effort to save you the unfold of the virus. To create secure surroundings that contributes to public protection, we endorse a green pc imaginative and prescient primarily based totally approach targeted at the real-time automatic tracking of human beings to discover each secure social distancing and face mask in public locations with the aid of using enforcing the version on raspberry pi4 to reveal pastime and discover violations via camera. After detection of breach, the raspberry pi4 sends alert sign to govern middle at nation police headquarters and additionally deliver alarm to public. In this proposed gadget current deep mastering set of rules had been

blended with geometric strategies for constructing a sturdy modal which covers 3 elements of detection, tracking, and validation. Thus, the proposed gadget favors the society with the aid of using saving time and allows in decreasing the unfold of corona virus. It may be carried out efficiently in present day state of affairs while lockdown is eased to look into individuals in public gatherings, buying malls, etc. Automated inspection reduces manpower to look into the general public and additionally may be utilized in any place.

3.5 Transferring Learning

Transfer studying is a system studying technique wherein a version evolved for a project is reused because the start line for a version on a 2nd project. It is a famous technique in deep studying wherein pre-educated fashions are used because the start line on pc imaginative and prescient and herbal language processing duties given the sizeable compute and time sources required to expand neural community fashions on those troubles and from the large jumps in ability that they offer on associated troubles. In this post, you may find out how you could use switch studying to hurry up education and enhance the overall performance of your deep studying version.

3.6 Basic working

First things first, we need to write some code for Arduinoto be able to interpret the commands we send it from our program that we're going to write in C# so let's come into our Arduino studios. Once we're in Arduino studio, we just want to create a new sketch. It opens with code blocks already set up for us to work upon. So first we import the server libraries. Now we declare a couple of servo variables for our x and y axis let's say servo serx, servo sery. So now in the setup function we can attach our servo pin. Let say we attach servo x to pin 10 on the arduino and servo y to pin 11. So now we can start listening for serial data. So let's just do serial dot begin and we can listen on baud rate 9600. 9600 is kind of just the default baud rate for serial communicate. At least on

Arduino. And then we set a time out for about 10 milliseconds. The reason we do this is, if we don't, the timeouts default length is a thousand milliseconds that is a second. So that causes like a one-second delay when you send commands to the to your hardware it's super annoying and this just fixes it. We can use some special event listeners specific to receiving serial event. Now let's actually a string serial data to prevent declare it each time we get serial input in this method now we can set serial data. Let's just use the read function to read the data being sent over to arduino oer serial communication. Now, what's the data structure for the serial communication we're going to use? The answer is whatever we want it to be. but for the sake of simplicity we're going to do something easy like, let's say the x-coordinate is a hundred and the y-coordinate is ninety as an example so it will send to be Y servo 90 and we want to send to the Xserve o 100. So to parse for X, we need to remove the character X and remove everything over here and for y we need to remove everything ahead of y. So now let's parse our data in a couple of separate functions so we can do in parse data let's parse data for X here and this is going to be taking in a string let's just call it 'data'. Then we can do the same thing for y so now we're going to be using the built-in ‘string.remove’ and ‘string.indexOf’ functions. By doing so, we just leave that number that represents the y and x coordinate and that's all for that now we can just return that data and convert it to integer. Now we use these functions that we just created so we can do serx.right and we can write the return of parse data X past that serial data value and and lets do the same for y. So let's get to work C#. Let's just go to file. new project then we are going to be selecting a win-forms application.A window formload opens up. It's a pretty tiny form it's just blank let's actually make that bigger we can look down in the properties here till we find size let's change that to 600 by 600 to just give us some room to move around. So next thing we're going to do is add a control for serial communication luckily WinForms provides something like that for it so we can just go up in our toolbox and look up 'serial' and we're going to drag-and-drop 'serial port' over to the form-load. It's going to pop up. Down there click on your serial. Make sure the settings are all right, let's see if, it's got a baud rate of 9600 which we're using. Make sure correct comport is selected on

which the arduino is connected. Now if we access the code behind this form we just hit the f7 key on our keyboard, alternatively you can just right click and hit 'view code'. So now we're viewing the code behind the form. Now we want to open our serial port so we can communicate with the Arduino. We could do that in the constructors but it's more friendly to do it on the event of form load and the shortcut to get this is just a double-click on the form and it will automatically write in this code snippet in. Here we give the command 'port.open'. Okay so we're going to be wanting to send serial data each time our mouse moves on this forum so we have an event listener for that. We come over to advance tools the little lightning bolt icon, and we'll scroll down to 'Mouse' and we're going to see the 'mousemove handler'. We'll just double click this and it will auto-populate just like that. So, it would be nice if we could just send the coordinates of the mouse pointer to disturbance right? Unfortunately we have to do a little more work than that we actually have to scale the forum size to the degrees of angular rotation of the motor. The reason is simple maths. Elaborating on that point our forum is 600 by 600 pixels compared to our turret which has a 180 degrees of angular rotation which is, the max rotation of a servo. So if we have an example point on the formload of say five hundred by five hundred we can't apply five hundred to something with a maximum input of 180. We need to scale it. we need a scaling constant, which is how much we need to scale these inputs to fit these inputs so to find a scaling constant for the x coordinates here it will be the same for y because it's a box. So let's actually set up a separate method for handling right data. So we give the command 'write.toPort'. This will also contain a scaling logic. Let's take an a point coordinate. So now, how are we going to express our scaling logic in C#? It could actually look complicated but it's really not so first off, we're just calling our serial port we're calling its write function, so we're writing whatever string is in here to our serial port or our Arduino. Inside of that we have a formatted string. So, we take our passed in coordinates and we divide it by the scaling constant so the scaling constant is taking the size of our form so just the width of our form which is 600 and dividing it by the angles of rotation of the servos which is 180 and we're doing the exact same thing for Y. So let's just pass in the event data we get from our

event listener. So, we can say 'write.toPort' and we're going to pass it a new point and initialize that with the mouse event arguments X.x for the x coordinate and Y.y for the y coordinate. But if we run the turret we get an entire second of latancy. This is happening because we're overloading our Arduino with serial data. We're sending it constantly as much as possible. So all we got to do is put a limiter on that. So we can give it like 15 milliseconds between sending serial data. We can do that with a stopwatch class really easily. We have to say import the library by typing in 'system.Diagnostics'. We want this stop watch and we'll call it 'watch'. All right, now we got that and let's initialize it on form load. Let's give the command 'watch= stopwatch.start new'. So this is just going to start the stopwatch from 0 and it's going to count up in milliseconds. Now we can just start the form up and we can go over here and while we get nice responsive controls.

3.7 Main Tasks

This system is suitable to be used in places where manual patrolling is difficult. Especially in areas with extreme weather and terrain conditions, like mountain tops and so on. The system is very useful in places were cases of infiltration and invasion are very high. This will help in not only preventing terrorism cts, but would also help in saving the lives of soldiers who, otherwise, would have to come in direct contact with terrorists or invadors.

3.8 Haar features for features extraction

A Haar-Feature is similar to a kernel in CNN, besides that during a CNN, the values of the kernel are decided via way of means of training, even as a Haar-Feature is manually decided. Haar-Features are suitable at detecting edges and lines. This makes it especial powerful in face detection. For example, in a small photograph of Beyoncé, this Haar-characteristic could be capable of come across her eye (a place this is darkish on pinnacle and brighter underneath).

3.9 Proposed CNN model

Convolutional neural network (CNN) has drawn lots interest to the studies community's mind-set and may be effectively embedded in a broader photograph type paradigm. It takes a photograph as input, assigns importance to distinctive gadgets inside a photograph primarily based totally on trainable weights & bias, and successfully differentiate every object. This paper introduces CNN primarily based totally sequential fashions to discover the presence of a man or woman inside a photograph. The well-known evaluation of those proposed fashions is proven in Table 1. These fashions encompass a convolutional layer, pooling layer, flatten, absolutely linked layer 1 & 2, and output layer. The best distinction among those fashions is that Model 1 includes convolutional layers with pooling layers, even as Model 2 includes 3 convolutional layers with 3 pooling layers. Due to this variation, Model 1 produces about 10,402,993 trainable parameters, while Model 2 produces about 2,861,297 trainable parameters.

3.10 Analysis

Statistics and reports svery clearly show that, most of the terrorism act in the border region of Indi involves terrorsits crossing the border nd infiltrating the nnational security. Most of these cases are there where guarding is difficult or where there are less BSF guards to guard the location. These terrorists, not only infiltrates the premises but also spread terrorism. Most of the soldiers dying in these area, die due to mines, bombs and other kind of explosive planted by these terrorist. And in a large number of cases, when the soldiers had to face cross firing with these terrorsit, soldiers die. The reason why such location are proned and exposed to such threats is the fact that its much more difficult to guard such location ue to human restrains, or sometimes due to these locations being too far away from the nearest army base.

CHAPTER – 4

Functionality

4.1 Object Detection and tracking

Object Detection and Image Classification are very famous obligations in pc vision. They have an extensive variety of programs in defense, healthcare, sports, and the distance industry. The essential distinction among those obligations is that photograph category identifies an item in a photograph while item detection identifies the item in addition to its place in a photograph.

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4.2 Evolution of State-of-the-Art (SOTA) for object detection

Object Detection is one of the maximum hard issues in pc vision. Having stated that, there was an enormous development during the last twenty years on this field. Object detection is the mission of detecting times of items of a sure magnificence inside an image. The modern techniques may be labeled into predominant types: one-degree techniques and degree-techniques. One-degree techniques prioritize inference speed, and instance fashions encompass YOLO, SSD and Retina-Net.

4.3 Sliding Window for Object Detection

The best technique to construct an Object Detection version is thru a Sliding Window technique. As the call suggests, a picture is split into areas of a specific length after which each area is **assessed** into the respective classes. Remember that the areas may be overlapping and ranging in length as well. It all relies upon at the manner you need to formulate the problem.

Model Workflow

1. Consider an image
2. Divide an image into regions (assume 10 * 10 region)
3. For each region:
    1. Pass a region to Convolutional Neural Network (CNN)
    2. Extract features from CNN
    3. Pass features to a classifier & regressor

This approach is clearly easy and efficient. But it’s a time-eating procedure because it considers the large quantity of areas for type. Now, we are able to see how we will lessen the quantity of areas for type withinside the subsequent approach. This may be added down via way of means of discarding the areas that aren't probably to comprise the item.

4.4 R-CNN for Object Detection

This system of extracting the areas which might be probably to comprise the item is referred to as Region Proposals. Region proposals have a better possibility of containing an item Many Region Proposal algorithms had been proposed to choose a Region of Interest (ROI). Someof the famous ones are objectness, selective search, category-unbiased item proposals, etc. So, R-

CNN changed into proposed with a concept of the usage of the outside vicinity inspiration algorithm. R-CNN stands for Region-primarily based totally Convolutional Neural Network. It makes use of one of the outside vicinity inspiration algorithms to choose the vicinity of interest (ROI).

Model Workflow

1. Consider an image
2. Select ROI using exterior region proposal algorithm
3. For each region:
    1. Pass a region to CNN
    2. Extract features from CNN
    3. Pass features to a classifier & regressor

The anticipated areas may be overlapping and ranging in length as well. So, Maximum Non Suppression is used to disregard the bounding containers relying upon the Intersection Over Union (IOU) score. Certainly, R-CNN's structure changed into the State of the Art (SOTA) on the time of the notion. But it consumes almost 50 seconds for each check photo at some point ofinference due to the wide variety of ahead passes to a CNN for function extraction. As you maylook at below the version workflow, each vicinity notion is handed to a CNN for function extraction. For example, if a photo has 2000 areas of proposals, then the wide variety of ahead passes to the CNN is round 2000. This necessarily brought about any other version structure referred to as Fast R-CNN.

4.5 Fast R-CNN for Object Detection

In order to lessen the inference speed, a mild alternate withinside the R-CNN workflow became made and proposed, referred to as Fast R-CNN. The change became achieved withinside the function extraction of location proposals. In R-CNN, function extraction takes location for every location suggestion whereas, in Fast R-CNN, function extraction takes location most effective as soon as for a unique photo. Then the applicable ROI functions are selected primarily based totally at the area of the location proposals. These location proposals are built earlier than passing a photo to CNN.

Model Workflow

1. Consider an image
2. Select Regions of Interest (ROI) using exterior region proposal algorithm
3. Pass an image to the CNN
4. Extract the features of an image
5. Choose relevant ROI features using the location of ROI
6. For each ROI feature, pass features to a classifier & regressor

4.6 Faster R-CNN for Object Detection

Faster R-CNN replaces the outdoors area notion set of rules with a Region Proposal Network (RPN). RPN learns to advocate the area of hobbies which in flip saves quite a few time and computation compared to a Fast R-CNN.

Model Workflow

1. Consider an image
2. Pass an image to CNN

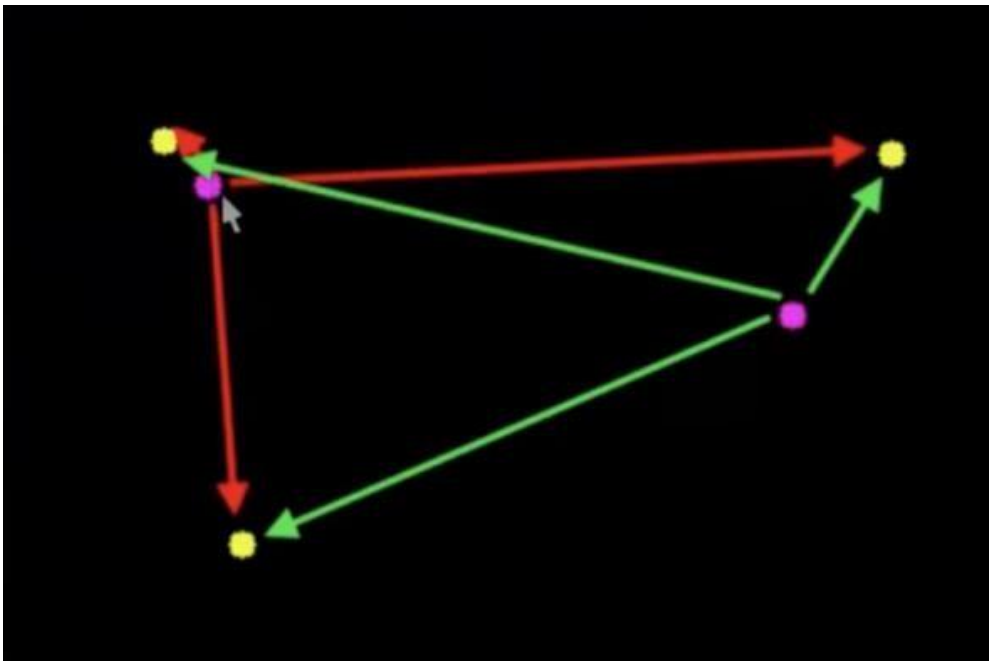
3. Extract the features of an image
4. Select ROI features using Region Proposal Network (RPN)
5. For each ROI feature, pass features to a classifier & regressor

CHAPTER – 5

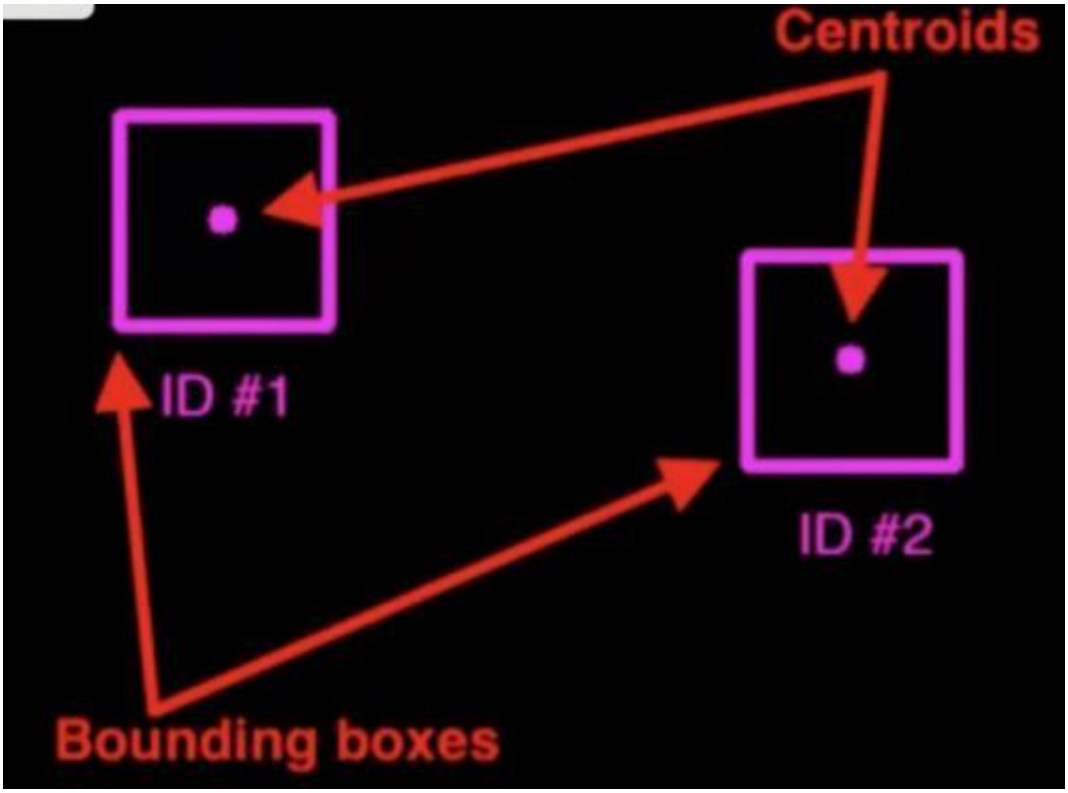
Working of Project

5.1 Detection

Then comes the part of detection of the human motion withinside the body for the Real Time Object Detection. To come across the motion of the pedestrians, a bounding container is needed for all of the pedestrians in order that their motion may be tracked from one factor to some other. Every time a brand new character seems withinside the body a brand new ID is assigned to the item. If for non-stop 50 frames an item does now no longer alternate function, the ID is re-registered. For detection an ID is assigned to every of the persons. Every time an item actions from one function to some other the ID is re-registered.



The image above portrays the detection of objects with the dots representing the centroids



The image above portrays the use of ID and bounding box around objects for the identification and recognition of the object.

5.2 OpenCV and JFrame Integration

For the fully automatic turret system, generation of coordinates that is needed to be processed and sent over via serial communication to the micro controller, we need OpenCV and JFrame to work in harmony. The video feed from the camera mounted on the turret is projected over a window formload created usinf JFrame. OpenCV processes the video feed frame by frame and puts a sliding window tracker on the target that is needed to be neutralized. The coordinates of the center of this sliding windows is then tconsidered and after applying a scaling factor, is sent over to the microcontroller to control the main turret that has a weapon attached to it. For the remote controlled part though, OpenCV is used just to project the video feed on the form load. The coordinates of the mouse pointer on the window formload are picked up using the inbuilt event listerner of the JFrame library. The

same prossess is repeated as it was done for Automatic system.

5.3 JAVA over C#

C# is one of the best languages out there to work with windows form load. A reason or that is the fact that it was developed by Microsoft, which as every one knows is a Operating System company and therefore specializes in using GUI at it's best. C# comes equipped with an entire library to work upon for utilizing the features of a form load. C# also comes with inbuilt library to use Serial Communication. The entire process is fairly easy in C# because of its very user friendly work flow an interface, especially when workin in Visual Studio as the IDE. We started the project on C# initially and were able to make the mouse controlled turret system quite easily. But later we switched the entire project to Java. The reason was quite simple. The efficiency of the entire system depends upon response time. Java is way faster than C# and we know that every millisecond matters in use cases such as this particular one, that is in field of weapons. 5-6 seconds can easily be shaved off by switching from C# to Java. Python was another language that we considered for the development of the system. In fact, OpenCV is known to be utilized best on Python as the programming language. In Java we needed to import libraries of OpenCV as well as, a library to enable serial communication, that is JseralComm. But still we chose to go with Java as time mattered a lot in the working of this entire project. Java is generally faster and more efficient than Python because it is a compact language. As a translated language, Python has a simpler, shorter syntax than Java. It can do the same job as Java in a few lines of code. The efficiency of the ava is largely due to its Just-In-Time (JIT) compiler and concurrency support. JIT compiler is part of the Java Runtime Environment. Improves the performance of Java applications by integrating bytecodes into the native "timed" code to work. Java Virtual Machine (JVM) calls the code directly compiled. Since code can be translated, compilation does not require processing time and memory usage. In theory, this could make the Java system faster as a traditional application. While Java applications are directly integrated, Python translates to slow down Python applications during

operation. Determining the type of variability that occurs during operation increases the burden on the interpreter. Also, remembering the type of object found in a container affects the use of memory.

CHAPTER – 6

Project Design

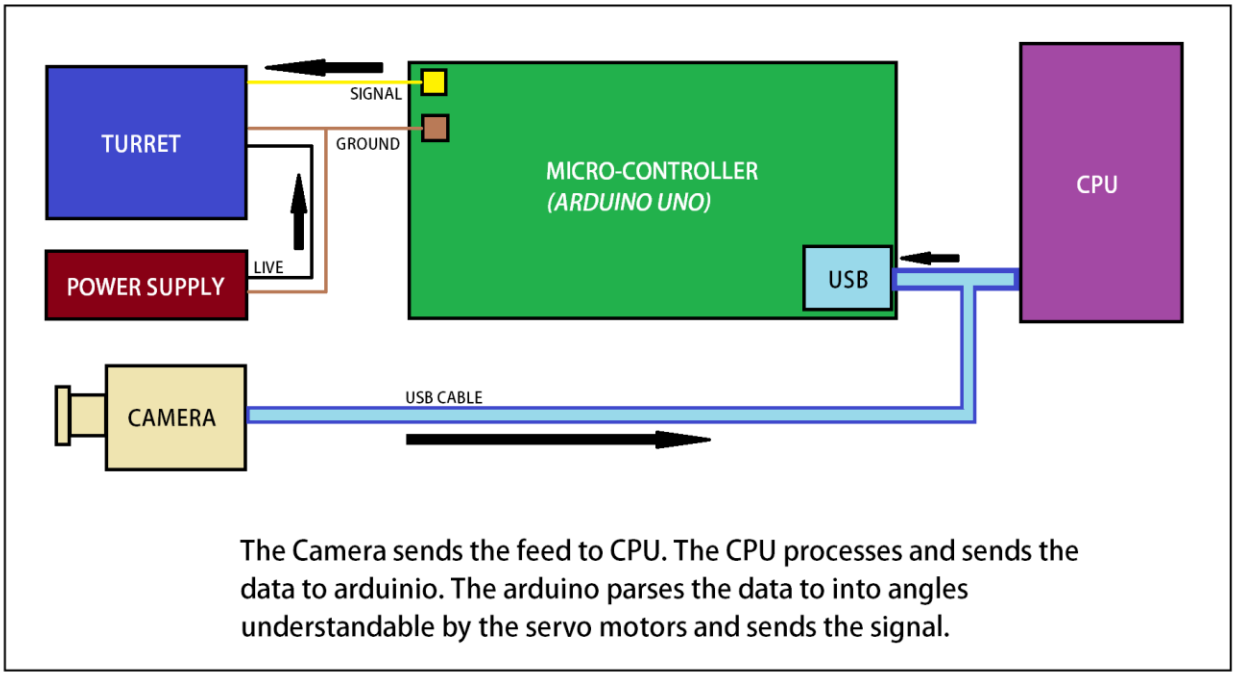
6.1 We can use OpenCV, JFrame, JserialComm and deep mastering to put into effect automatic turret system

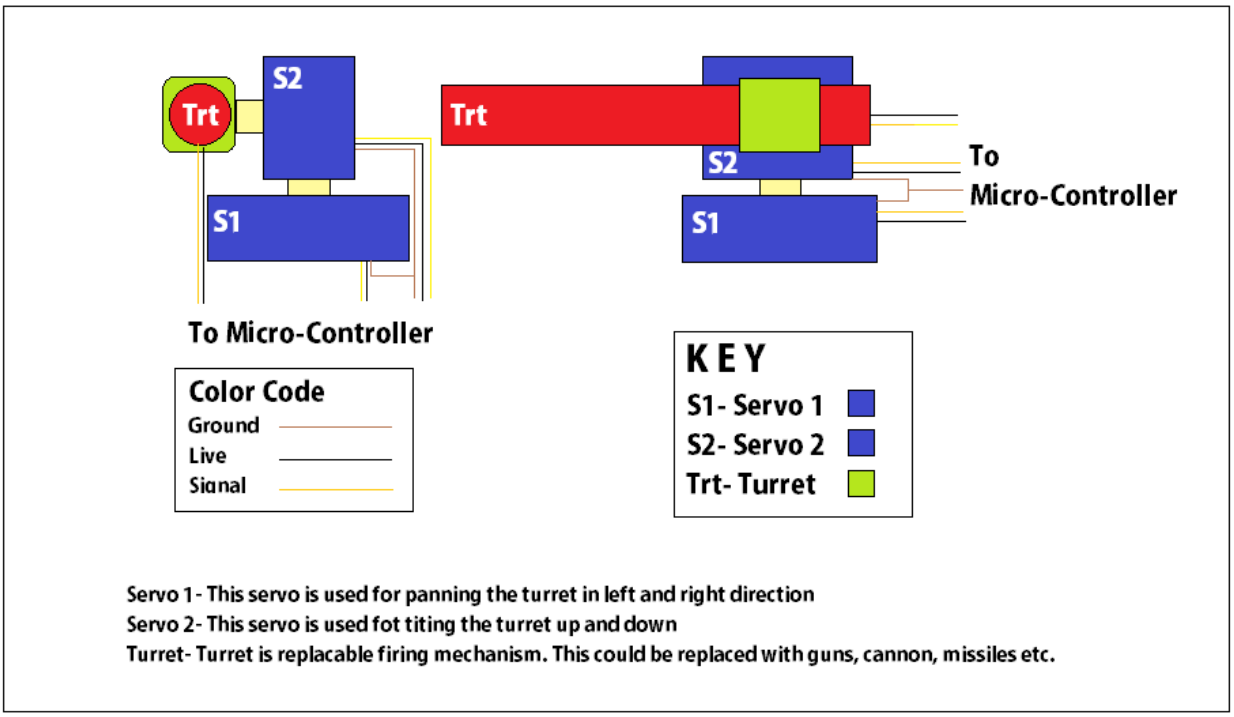
The steps to construct a social distancing detector include:

- Apply item detection to locate all humans (and most effective humans) in a video stream (see this academic on constructing an OpenCV humans counter)
- Compute the pairwise distances among all detected humans
- Based on those distances, take a look at to peer if any humans are much less than N pixels apart for the maximum correct results, you need to calibrate your digital digicam thru intrinsic/extrinsic parameters so you can map pixels to measurable units.

For the maximum correct results, you ought to calibrate your digital digicam via intrinsic/extrinsic parameters so you can map pixels to measurable units. A less difficult alternative (however much less correct) approach might be to use triangle similarity calibration (as mentioned on this tutorial). Both of those strategies may be used to map pixels to measurable units. Finally, in case you do now no longer want/cannot observe digital digicam calibration, you could nonetheless make use of a social distancing detector, however you'll should depend strictly at the pixel distances, which won't always be as correct. For the sake of simplicity, our OpenCV social distancing detector

implementation will rely upon pixel distances — I will depart it as an workout for you, the reader, to increase the implementation as you notice fit.





6.2 Project Structure

Faster R CNN, Mask R CNN, and Retina-Net for solving different computer vision tasks, such as:

1. Object Detection
2. Instance Segmentation
3. Key point Detection
4. Panoptic Segmentation

The baseline fashions of Faster R-CNN and Mask R-CNN are to be had with three kind of combinations.

6.3 Source code

MAIN JAVA FILE

```
package com.laserturret.arduino.example;

import java.awt.BorderLayout;
import java.awt.Dimension;
import java.awt.event.MouseEvent;
import java.awt.event.MouseMotionListener;
import java.io.IOException;
import java.util.Scanner;
import java.util.Timer;
import java.util.TimerTask;

import javax.swing.JFrame;
import javax.swing.JLabel;
import javax.swing.JPanel;
import com.fazecast.jSerialComm.SerialPort;

public class GUI implements MouseMotionListener{
	public GUI() {
	;
	}
	public Integer x=0,y=0;
	public Integer turret=0;
//Constructor to create GUI of JFRAME
	public GUI(int height, int width) {

	JFrame frame  =  new JFrame();
	JPanel panel = new JPanel();
	frame.setPreferredSize(new Dimension(height, width));
	frame.add(panel,BorderLayout.CENTER);
	frame.setTitle("Laser Turret System GUI");
	frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
	frame.add(new JLabel("Hover on this area to move turret position"));
	frame.pack();
```

```
        frame.setResizable(false);
        frame.setVisible(true);
        frame.addMouseMotionListener(this);
        }
        public static Integer l;
        public static Integer w ;
        public byte [] data = new byte[3];

// Driver Method
        public static void main(String[] args) throws IOException, InterruptedException {
        System.out.println("Enter the dimensions of your camera in pixels");
        Scanner sc = new Scanner(System.in);
        final GUI n = new GUI();
        l=sc.nextInt();
        w = sc.nextInt();

        new GUI(n.l,n.w);
//serial communication
        final SerialPort sp = SerialPort.getCommPort("/dev/ttyACM0"); // device name TODO: must be
        changed
        sp.setComPortParameters(9600, 8, 1, 0); // default connection settings for Arduino
        sp.setComPortTimeouts(SerialPort.TIMEOUT_WRITE_BLOCKING, 0, 0); // block until bytes can be
        written

        if (sp.openPort()) {
            System.out.println("Port is open :)");
        } else {
            System.out.println("Failed to open port :(");
            return;
        }

        //use timer function here
         Timer timer = new Timer();
         TimerTask task = new TimerTask() {

            @Override
            public void run(){
                    // TODO Auto-generated method stub
                    n.data[0]=10;
                    n.data[1]=50;
                    n.data[2]=n.turret.byteValue();
                    try {
                    for(int i = 0; i<3;i++) {
                                    sp.getOutputStream().write(n.data[i]);
                                    sp.getOutputStream().flush();
                                    System.out.println("Sent BYTE: " + n.data[i]);
                                    Thread.sleep(500);}


                            } catch (Exception e) {
                                    // TODO Auto-generated catch block
                                    System.out.println("Error in continious data streaming");


                    }
             }
            };
```

```
                timer.schedule(task, 100);


            }

    // Methods to revoke coordinates and on off state of the turret

            public void mouseDragged(MouseEvent e) {
            // TODO Auto-generated method stub
            e.consume();
            x=e.getX()*(l/180);
            y=e.getY()*(w/180);
            turret = 1;

            System.out.println("X:"+e.getX()+" Y:"+e.getY()+ " Turret is On: "+turret);
            }

            public void mouseMoved(MouseEvent e) {
            // TODO Auto-generated method stub
            e.consume();
            x=e.getX()*(l/180);
            y=e.getY()*(w/180);
            turret = 0;

            System.out.println("X:" + e.getX() +" Y:"+ e.getY()+ " Turret is On: "+turret);
            }


            }
```

ARDUINO CODE

```
#include<Servo.h>
Servo myServo;
void setup() {
  // put your setup code here, to run once:
  myServo.attach(8);
  Serial.begin(9600);
  Serial.setTimeout(10);


}

void loop() {
    if(Serial.available()>0){
      byte data =readData();
      if(data){
        myServo.write(180);
        Serial.println(data);
        }
      }
}
 byte readData(){
  byte incomingByte = Serial.read();
```

```
 return incomingByte;
 }
```

CONFIGURATION FILE

```
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 https://maven.apache.org/xsd/maven-4.0.0.xsd">
   <modelVersion>4.0.0</modelVersion>
 <groupId>de.mschoeffler.arduino.serialcomm</groupId>
 <artifactId>de.mschoeffler.arduino.serialcomm.example02</artifactId>
 <version>0.0.1-SNAPSHOT</version>
 <name>ArduinoBasicExample</name>
 <build>
  <sourceDirectory>src</sourceDirectory>
  <plugins>
   <plugin>
    <artifactId>maven-compiler-plugin</artifactId>
    <version>3.5.1</version>
    <configuration>
     <source>1.8</source>
     <target>1.8</target>
    </configuration>
   </plugin>
  </plugins>
 </build>
 <dependencies>
          <dependency>
           <groupId>com.fazecast</groupId>
           <artifactId>jSerialComm</artifactId>
           <version>1.3.11</version>
         </dependency>
 </dependencies>
</project>
```

CHAPTER-7

Results and discussion

7.1 Points to remember

Keep in thoughts that the projection of the digital digicam additionally topics lots whilst computing the space among the gadgets in an image. In our case, we actually have now no longer taken into consideration the projection of the digital digicam because the effect of the digital digicam's projection at the predicted distance is minimum. However, the frequent method is to transform a video right into a pinnacle view or birds' eye view after which compute the space among gadgets in an image. Also this issue could pose a huge threat in cases of misfires, especially when the turret is not supposed to target and neutralize a friendly army personal or some innocent civilian, therefore it is advised that in cases where there is expected trespassing of friendlies or some innocent civilian, the turret is switched from automatic to remote control mode to ensure the safety of everyone.

7.2 End Notes

This article shows deep mastering primarily based totally human detection strategies to screen

Invadors and invasion withinside the real-time environment and neutralize the infiltrator. These strategies were advanced with the assist of deep convoluted community that has used sliding window idea as a location proposal. The great experiments have been accomplished with CNN primarily based totally item detectors. In experiments, it's miles discovered that CNN- primarily based totally item detection fashions are higher in accuracy than others. Sometimes, it produces a few fake wonderful times while coping with real-time video sequences. In the destiny,

distinct cutting-edge item detectors like RCNN, Faster RCNN, SSD, RFCN, YOLO, etc. can be deployed with the self-created dataset to boom detection accuracy and decrease the fake wonderful times. Additionally, a unmarried standpoint received from a unmarried-digital digicam can't mirror the end result extra effectively. Therefore, the proposed set of rules can be set for distinct perspectives thru many cameras withinside the destiny to get extra correct results.

7.3 Limitations

There are some barriers of the turret system that are indexed as below:

1. The first aspect that may be advanced is the digital digicam calibration, which eases the mapping of the space in pixels to the real gadgets of measurements of distance.

2. The 2d aspect that may be advanced is the digital digicam perspective, a higher technique might be to apply the bird's eye view perspective which is likewise called the top- down transformation.

3. The automatic mode can never be fully reliable as there are going to be false positives, which can cause deaths of innocent people, therefor it should strictly be only used in places where no civilian or even friendly army personal is supposed to be present.

7.4 Advantages of deep learning models

Image type includes dispensing a class label to a picture, while item localization includes drawing a bounding field round one or a number of gadgets in a picture. Object detection is harder and combines those 2 responsibilities and draws a bounding field round each item of hobby in the photo and assigns them a class label. Together, all of these problems square degree noted as seeing.

1. Deep studying fashions have the functionality to generate new functions from the constrained dataset that they to begin with were educated with.

2. The fashions on being educated constantly emerge as bendy and adapt to extrude quickly.

3. The deep studying fashions are able to studying via unlabeled records which reduces a number of price for labelling records to assist the system to research without difficulty as in case of supervised studying.

4. Deep studying fashions as soon as educated effectively are able to acting repetitions without taking tons' time and do now no longer get tired.

CHAPTER – 8

Conclusion and future scope

8.1 AI powered Turret System results

The result is a protoype device that can change the scene in defenes system entirely and could be the path to a new generation of warfare. This would really benefit in saving the lives of many innocent civilian as well as lives of army personal. Defense system or Agriculture can be greatly benefited if we could automate manual work using iOT and AI; Lives of soldiers andalso huge amount of time of peasants and labor work could be reduced drastically with the help of this system. iOT and AI is being already used in today's defense as well as irrigation system. We already have such systems available but the idea here is to reducethe costing of the project and also make it easily accessible and also increase the ease of use and maintenance. Moreover, use of this system already has its own advantage in defense as well as in irrigation system. We will focus on the defense side of the application, where we will use an AI powered computer system to guide, aim and fire a gun through a robotic turret system. The systemcan be mounted and deployed in sensitive areas where manual guarding is hard and number of infiltration cases is high.

8.2 Conclusion

A device for detecting the presence of invadors in an area where they are not supposed to be and neutralize them. A system that can work fully automatically and can also be switched to remote controlled mode for extra reliability.

8.3 Future Scope

The future scope of the project is addition of face detection along with the atomatic human

presence system, which will allow authorized personal to roam around freely in the prmises where the system has been installed, this would totally eliminate the possibility of false positive that neutralizing a friendly personal. The project also opens up various other paths to other weapon system that can be automated in the warfare. This includes automatic grenade, that can follow the target and only lands on the target when the entire fuse has been burnt out. Also fully automatic portable handguns can be a possibility in near future.

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