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WEAPON DETECTION USING ARTIFICIAL INTELLIGENCE AND DEEP LEARNING FOR SECURITY APPLICATIONS

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ABSTRACT

From many statistics, it can be assumed that the violence rate concerning guns and harmful weapons is increasing every year, becoming a challenge for law enforcement agencies to deal with this issue on time. There are many places where the crime rate caused by guns or knives is very high, especially in places where there are no gun control laws. The early detection of violent crime is of paramount importance for citizens' security. One way to prevent these situations is by detecting the presence of dangerous weapons such as handguns and knives through surveillance videos. Present surveillance and control systems still require manual monitoring and intervention. Here, we present a system of automatic detection of weapons in the video, which is appropriate for surveillance and control purposes. We have used the CNN algorithm for the detection of weapons in real-time video. The CNN models are end-to-end deep learning models and are well-liked because of their detection speed and accuracy. Previous methods, like region-based convolutional neural networks (R-CNN), require thousands of network evaluations to make predictions for one image which can be time-consuming and painful to optimize. It focuses on a specific area of the image and trains each component separately. A CNN model on the other hand only passes the image once through the neural network. Since, in a real- time video, speed is of paramount importance, we have used the CNN algorithm. The dataset is trained for classifying three classes of weapons Handgun, Knife, and Heavy Guns. Once the weapon is detected, an alert will be sent to authorities who can act accordingly and reduce the violent crimes before they take place.

Keywords: Terrorist attacks, Surveillance, Public safety and Security.

1. INTRODUCTION

In recent years, the number of gun-related incidents has exceeded 250,000 per year and 85% of the 1 billion guns in existence are civilians. Even in areas not directly affected by the attack, terrorist attacks cause fear and anxiety among the public. This leads to a decrease in tourism, economic activities and general insecurity in the community. Terrorist attacks pose significant challenges to public safety and security, and can have devastating consequences for individuals and society as a whole. Weapon detection is the process of identifying and classifying various types of weapons in public places. It is an important technology that has received significant attention in recent years due to increasing concerns about public safety and security. Weapon detection using Convolutional Neural Networks (CNNs) is a popular approach to automatically detect and classify weapons in images or videos. CNNs are a type of deep learning model that have revolutionized the field of computer vision by helping machines learn and recognize patterns in images and videos. Various automated Convolutional Neural Networks (CNN) weapon detection systems have been proposed in the past to produce good results. They have been shown to be effective in detecting weapons in real-world scenes, and their ability to learn complex patterns and identify objects in real-time makes them a powerful tool in the fight against terrorism. In this paper, we explore the application of

CNNs in weapons detection technology, highlighting their advantages and challenges. Detect armed persons, recognize their face and find out who is holding the weapon and SMS will be sent to the higher authority present, then a warning sound is raised to the public. A warning is issued. This weapon detection system is very effective and the death rate caused by terrorists will be reduced. Artificial intelligence (AI) is a branch of computer science that focuses on the development of intelligent machines and systems that can perform tasks that typically require human intelligence, such as visual perception, speech recognition, decision making, and natural language processing. AI systems are designed to learn from data and experience, enabling them to adapt and improve their performance over time. This is achieved by using machine learning algorithms, which allow computers to recognize patterns and relationships in data and make predictions based on that information. AI has a wide range of applications in various industries including healthcare, finance, transportation and manufacturing.

For example, AI can be used to create personalized healthcare plans, detect fraud in financial transactions, improve traffic management systems, and improve production processes in factories. The field of AI is constantly evolving and advancing with new developments and innovations every day. These include advances in deep learning, natural language processing, computer vision and robotics, which open up new possibilities for how AI can be used in different domains. We use deep learning to detect the presence of a weapon, Deep learning is a subfield of machine learning based on artificial neural networks (ANNs) that are inspired by the structure and function of the human brain. Deep learning algorithms are designed to learn multilevel representations from data using multiple layers of neural networks. Deep learning has become a powerful tool for solving complex problems such as image and speech recognition, natural language processing, and autonomous driving. It has produced cutting-edge results in many domains and enabled the development of advanced technologies such as facial recognition, voice assistants and self-driving cars. The success of deep learning is due to its ability to automatically learn useful features or representations from input data without the need for manual feature engineering. It accomplishes this by using large amounts of labeled training data and backpropagation algorithms to adjust the neural network's weights and biases. Deep learning models can make accurate predictions and classify complex data with high accuracy. They can also be used to create new data such as creating realistic images, video and audio. After confirming the presence of the weapon, facial recognition is used to detect the reach of the weapon holder's face. Face recognition is the process of identifying or verifying the identity of an individual based on their facial features. It involves using algorithms and computer vision techniques to analyze an image or video of a person's face and compare it to a database of known faces to determine a match. Facial recognition technology has become increasingly prevalent in recent years and is used in a variety of applications, such as security systems, social media, and even unlocking smartphones. The technology works by analyzing unique facial features, such as the distance between the eyes, the shape of the nose and mouth, and the contours of the face. There are two main approaches to facial recognition: 1) traditional methods that rely on geometric measurements of facial features, and 2) deep learning techniques that use artificial neural networks to learn and recognize patterns in facial data. After detecting the presence of a weapon, an alert is sent via SMS to the senior officer present. A warning sound is sounded to the public present there to prevent any danger.

2. LITERATURE SURVEY

BAO WENXIA, REN YANGXUN, LIANG DONG, YANG XIANJUN, XU QIUJU ET AL PROPOSED "FIRE AND GUN DETECTION BASED ON SEMATIC EMBEDDINGS" IEEE-2022 - It is critical that real-time gun and fire detection from video be accurate to protect life, property and the environment. Recent advances in deep machine learning have greatly improved detection accuracy in this domain. In this paper, a semantic embedding-based method is developed for zero-shot gun and fire detection. Using a pre-trained Contrastive Language-Image Pre-Training (CLIP) model, input images and arbitrary texts can be mapped to semantic vectors and their similarity can be computed. By defining object classes using the semantic vector of each classes' description, highly accurate object detection accuracy can be achieved without training any new model. Evaluation of this method on public domain FireNet and IMFDB datasets demonstrates fire and gun detection accuracy of 99.8% and 97.3%, respectively, which significantly outperforms state of the art FireNet and Deep Nural Network (DNN) algorithms. Semantic embedding enables open set semantic search in video and simplifies deploying and maintaining object detection.

JESUS RUIZ-SANTAQUITERIA, ALBERTO VELASCO-MATA, NOELIA VALLEZ, GLORIA BUENO ET AL PROPOSED "HANDGUN DETECTION USING COMBINED HUMAN POSE AND WEAPON APPEARANCE" IEEE-2021 - Closed-circuit television (CCTV) systems are essential nowadays to prevent security threats or dangerous situations, in which early detection is crucial. Novel deep learning-based methods have allowed to develop automatic weapon detectors with promising results. However, these approaches are mainly based on visual weapon appearance only. For handguns, body pose may be a useful cue, especially in cases where the gun is barely visible. In this work, a novel method is proposed to combine, in a single architecture, both weapon appearance and human pose information. First, pose keypoints are estimated to extract hand regions and generate binary pose images, which are the model inputs. Then, each input is processed in different subnetworks and combined to produce the handgun bounding box. Results obtained show that the combined model improves the handgun detection state of the art, achieving from 4.23 to 18.9 AP points more than the best previous approach.

RAJIB DEBNATH, MRINAL KANTI BHOWMIK ET AL PROPOSED "AUTOMATIC VISUAL GUN DETECTION CARRIED BY A MOVING PERSON" IEEE-2021 - Few works are reported in firearm detection, even though, it has an important application in both the field of video forensic analysis and surveillance. Security of different crowded areas such as around airport, marketplace, places of worships, shopping mall, ceremonies events such as marriage, parties etc. always have a requirement of automatic detection of moving person carrying illegal weapon. In the present scope of the work, we propose a gun detection technique based on template matching which is invariant to scale & rotation. Template matching is a simple and traditional method used for object recognition with a disadvantage of high time complexity. We propose an innovative yet simple way to reduce the time complexity by employing a background subtraction methodology. Background subtraction algorithm handles other challenges too, such as sudden change of illumination. Experimental results illustrate that the proposed method outperforms efficiently in gun detection in video sequences with lesser number of True negatives in comparison with state-of-the-art template matching algorithms.

MUHAMMAD TAHIR BHATTI, MUHAMMAD GUFRAN KHAN, MASOOD ASLAM, MUHAMMAD JUNAID FIAZ ET AL PROPOSED "WEAPON DETECTION IN REAL-TIME CCTV VIDEOS USING DEEP LEARNING" IEEE-2021 - Security and safety is a big concern for today's modern world. For a country to be economically strong, it must ensure a safe and secure environment for investors and tourists. Having said that, Closed Circuit Television (CCTV) cameras are being used for surveillance and to monitor activities i.e. robberies but these cameras still require human supervision and intervention. We need a system that can automatically detect these illegal activities. Despite state-of-the-art deep learning algorithms, fast processing hardware, and advanced CCTV cameras, weapon detection in real-time is still a serious challenge. Observing angle differences, occlusions by the carrier of the firearm and persons around it further enhances the difficulty of the challenge. This work focuses on providing a secure place using CCTV footage as a source to detect harmful weapons by applying the state of the art open-source deep learning algorithms. We have implemented binary classification assuming pistol class as the reference class and relevant confusion objects inclusion concept is introduced to reduce false positives and false negatives. No standard dataset was available for real-time scenario so we made our own dataset by making weapon photos from our own camera, manually collected images from internet, extracted data from YouTube CCTV videos, through GitHub repositories, data by university of Granada and Internet Movies Firearms Database (IMFDB) imfdb.org. Two approaches are used i.e. sliding window/classification and region proposal/object detection. Some of the algorithms used are VGG16, Inception-V3, Inception-ResnetV2, SSDMobileNetV1, Faster-RCNN Inception-ResnetV2. Precision and recall count the most rather than accuracy when object detection is performed so these entire algorithms were tested in terms of them. Yolov4 stands out best amongst all other algorithms and gave a F1-score of 91% along with a mean average precision of 91.73% higher than previously achieved.

BAO WENXIA, REN YANGXUN, LIANG DONG, YANG XIANJUN, XU QIUJU ET AL PROPOSED "DEFECT DETECTION ALGORITHM OF ANTI-VIBRATION HAMMER BASED ON IMPROVED CASCADE R-CNN" IEEE-2020 - Aiming at the problem that it is difficult to accurately locate and identify the defects of anti-vibration hammer components in high-voltage transmission lines, this paper propose a detection method for anti-vibration hammer defects based on the improved Cascade R-CNN algorithm. In dataset: Firstly, this research constructs a dataset of anti-vibration hammer defects based on common anti-vibration hammer defect categories; secondly, this research performs preprocessing methods such as cropping, flipping, gamma

transformation and CLAHE on training samples to improve the generalization ability of the network and avoid over-fitting. In algorithm: This research use ResNeXt-101 as the backbone network of the Cascade R-CNN algorithm; add FPN module for extracting multi-scale features to extract more effective information; use Focal Loss function to improve the classification loss of RPN module to solve the dataset category imbalance problem. Experimental results show that the improved Cascade R-CNN algorithm has a detection accuracy of 91.2% on the anti-vibration hammer defect test set, which is 3.5% higher than the original Cascade R-CNN algorithm and is better than other mainstream object detection algorithms.

3. MODULE DESCRIPTION

Image dataset collection
Image preprocessing
Importing modules
Training the dataset
Camera interfacing
Test the output

4. EXISTING SYSTEM

Security and safety are a big concern for today's modern world. For a country to be economically strong, it must ensure a safe and secure environment for investors and tourists. Closed Circuit Television (CCTV) cameras are being used for surveillance and to monitor activities i.e. robberies but these cameras still require human supervision and intervention. Innovative deep learning-based techniques have made it possible to develop automatic weapon detectors with promising results. To extract the hand regions and generate binary pose images that serve as model inputs, the pose key points must first be approximated. A final bounding box is formed by combining the results of processing each input across multiple subnetworks. Findings Composite model improves handgun detection status. This existing paper implements automatic gun (or) weapon detection using a RNN algorithms. Observing angle differences, occlusions by the carrier of the firearm and persons around it further enhances the difficulty of the challenge. This work focuses on providing a secure place using CCTV footage as a source to detect harmful weapons by applying the state of the art open-source deep learning algorithms.

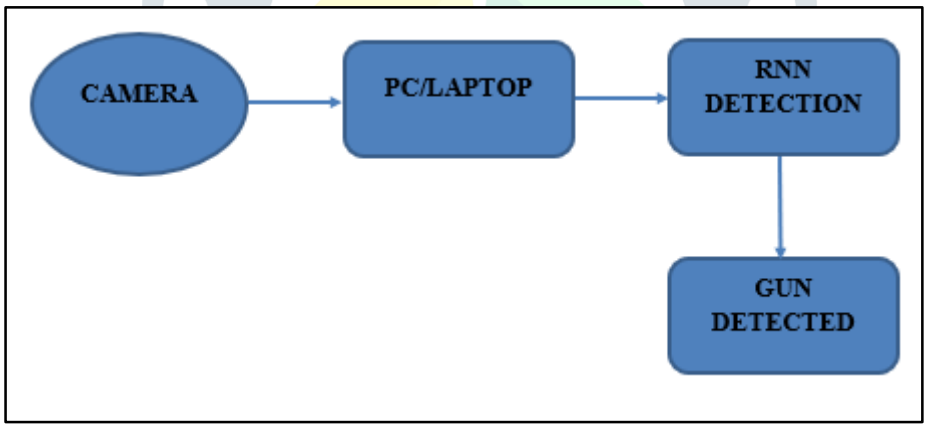

Fig: 1 EXISTING SYSTEM BLOCK DIAGRAM

5.PROPOSED SYSTEM

A serious and often fatal incident, an armed attack in a public setting can have long-lasting effects on individuals, communities and society as a whole. These types of events can result in physical injury, psychological anguish and financial loss. In addition, they can cause fear in the public and call for increased security. Following an armed attack in a public area, it is critical for law enforcement to initiate a comprehensive investigation to determine the motivations of the attackers and any possible links to larger criminal or terrorist organizations. Our research. Using CNN, a deep learning technique, our model can distinguish photos of weapons. Convolutional neural networks are used to transform these images into useful data in the form of evaluation matrices. The model is then generated by CNN algorithms. When we provide the input image, the process is finally executed. Finally, using

the output from our deep learning model, find out. The results were truly gratifying. This detection method significantly helps in detecting the use of image of weapons. If one or more people use a firearm in a public place, upon detection of the firearm. Alert SMS and alert beep sound with deep sound. The face of the weapon holder is identified using a facial recognition system.

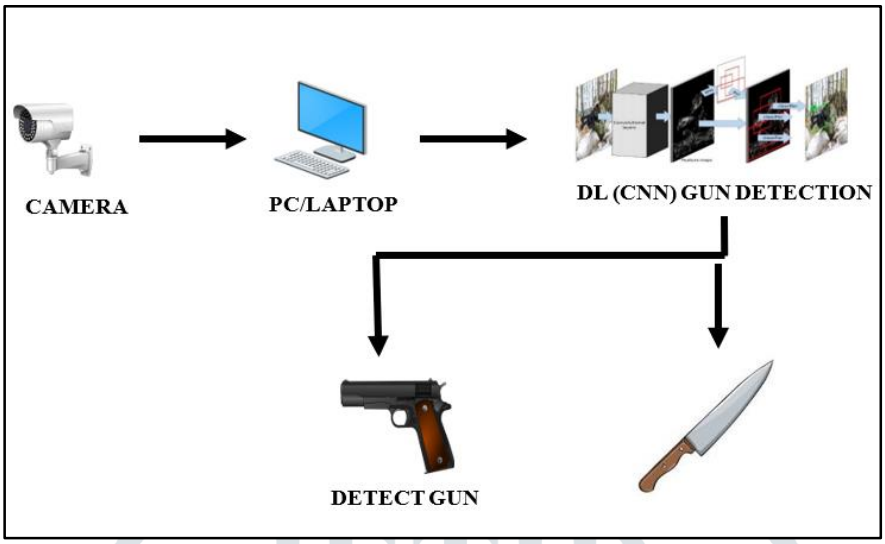

Fig: 2 PROPOSED SYSTEM BLOCK DIAGRAM

6. SOFTWARE DESCRIPTION

PYTHON
TENSORFLOW
KERAS
NUMPY
PILLOW
SCIPY
OPENCV
CONVOLUTIONAL NEURAL NETWORK (CNN)

6.1 PYTHON

Python is an interpreted language, which precludes the need to compile code before executing a program because Python does the compilation in the background. Because Python is a high-level programming language, it abstracts many sophisticated details from the programming code. Python focuses so much on this abstraction that its code can be understood by most novice programmers.

Python code tends to be shorter than comparable codes. Although Python offers fast development times, it lags slightly in terms of execution time. Compared to fully compiling languages like C and C++, Python programs execute slower. Of course, with the processing speeds of computers these days, the speed differences are usually only observed in benchmarking tests, not in real-world operations. In most cases, Python is already included in Linux distributions and Mac OS X machines.

Python is a dynamic, high level, free open source and interpreted programming language. It supports object –oriented programming as well as procedural oriented programming. Python is a very easy to code as compared to other language like c, c ++, java etc. It is also a developer friendly language. Python is also an integrated language because we can easily integrated python with other language like c, c ++, etc.

6.2 OPEN CV

Open CV tutorial provides basic and advanced concepts of OpenCV. Our Open CV tutorial is designed for beginners and professionals. OpenCV is an open-source library for the computer vision. It provides the facility to the machine to recognize the faces or objects. In this tutorial we will learn the concept of OpenCV using the Python programming language. Our OpenCV tutorial includes all topics of Read and Save Image, Canny Edge Detection, Template matching, Blob Detection, Contour, Mouse Event, Gaussian blur and so on. What is OpenCV? - OpenCV is a Python open-source library, which is used for computer vision in Artificial intelligence, Machine Learning, face recognition, etc. In OpenCV, the CV is an abbreviation form of a computer vision, which is defined as a field of study that helps computers to understand the content of the digital images such as photographs and videos. The purpose of computer vision is to understand the content of the images. It extracts the description from the pictures, which may be an object, a text description, and three-dimension model, and so on. For example, cars can be facilitated with computer vision, which will be able to identify and different objects around the road, such as traffic lights, pedestrians, traffic signs, and so on, and acts accordingly. Computer vision allows the computer to perform the same kind of tasks as humans with the same efficiency. There are a two main task which are defined below:

6.3 PYTHON PILLOW — OVERVIEW

In today's digital world, we come across lots of digital images. In case, we are working with Python programming language, it provides lot of image processing libraries to add image processing capabilities to digital images. Some of the most common image processing libraries are: OpenCV, Python Imaging Library (PIL), Scikit-image, Pillow. However, in this tutorial, we are only focusing on Pillow module and will try to explore various capabilities of this module. Pillow is built on top of PIL (Python Image Library). PIL is one of the important modules for image processing in Python. However, the PIL module is not supported since 2011 and doesn't support python 3. Pillow module gives more functionalities, runs on all major operating system and support for python 3. It supports wide variety of images such as "jpeg", "png", "bmp", "gif", "ppm", "tiff". You can do almost anything on digital images using pillow module. Apart from basic image processing functionality, including point operations, filtering images using built-in convolution kernels, and color space conversions.

6.4 IMAGE ARCHIVES

The Python Imaging Library is best suited for image archival and batch processing applications. Python pillow package can be used for creating thumbnails, converting from one format to another and print images, etc.

6.5 IMAGE DISPLAY

You can display images using Tk Photo Image, Bitmap Image and Windows DIB interface, which can be used with Python Win and other Windows-based toolkits and many other Graphical User Interface (GUI) toolkits. For debugging purposes, there is a show () method to save the image to disk which calls the external display utility.

6.6 KERAS

Keras runs on top of open-source machine libraries like TensorFlow, Theano or Cognitive Toolkit (CNTK). Theano is a python library used for fast numerical computation tasks. TensorFlow is the most famous symbolic math library used for creating neural networks and deep learning models. TensorFlow is very flexible and the primary benefit is distributed computing. CNTK is deep learning framework developed by Microsoft. It uses libraries such as Python, C#, C++ or standalone machine learning toolkits. Theano and TensorFlow are very powerful libraries but difficult to understand for creating neural networks. Keras is based on minimal structure that provides a clean and easy way to create deep learning models based on TensorFlow or Theano. Keras is designed to quickly define deep learning models. Well, Keras is an optimal choice for deep learning applications.

Deep learning is an evolving subfield of machine learning. Deep learning involves analyzing the input in layer-by-layer manner, where each layer progressively extracts higher level information about the input. Let us take a simple scenario of analyzing an image. Let us assume that your input image is divided up into a rectangular grid of pixels. Now, the first layer abstracts the pixels. The second layer understands the edges in the image. The Next

layer constructs nodes from the edges. Then, the next would find branches from the nodes. Finally, the output layer will detect the full object. Here, the feature extraction process goes from the output of one layer into the input of the next subsequent layer. By using this approach, we can process huge number of features, which makes deep learning a very powerful tool. Deep learning algorithms are also useful for the analysis of unstructured data. Let us go through the basics of deep learning in this chapter.

6.7 FACIAL RECOGNITION SYSTEM

A facial recognition system is a technology capable of identifying or verifying a person from a digital image or a video frame from a video source. There are multiple methods in which facial recognition systems work, but in general, they work by comparing selected features from given image with faces within a database. It is also described as a Biometric Artificial Intelligence based application that can uniquely identify a person by analysing patterns based on the person's facial textures and shape.

While initially a form of computer application, it has seen wider uses in recent times on mobile platforms and in other forms of technology, such as robotics. It is typically used as access control in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems.[2] Although the accuracy of facial recognition system as a biometric technology is lower than iris recognition and fingerprint recognition, it is widely adopted due to its contactless and non-invasive process.[3] Recently, it has also become popular as a commercial identification and marketing tool.[4] Other applications include advanced human-computer interaction, video surveillance, automatic indexing of images, and video database, among others.

7. CONCLUSION

Project weapon detection involves various issues, weapon detection from surveillance videos is not only a challenging problem of human detection and human activity recognition in the field of computer vision, but also an urgent need for real-life crime prevention. Therefore, various technologies should be explored to detect and address those who use weapons in densely populated areas. Image processing techniques are implemented in the research work and get better results in weapon and face detection. There are several ways to improve the proposed method over longer lengths using modern security methods. For example, a high-resolution camera can be used to take photos of a person attempting to steal or assault. Data communications and networking is an upcoming field that can be used to achieve better performance in this area.

8. REFERENCES

[1] Wei Liu et al., "SSD: Single Shot Multibook Detector", *European Conference on* Computer *Vision*, vol. 169, pp. 20-31, Sep. 2017.
[2] V. P. Korakoppa et al., "An area efficient FPGA implementation of moving object detection and face detection using adaptive threshold method", *International Conference on Recent Trends in Electronics Information & Communication Technology*, 2017.
[3] H R Rohit et al., "A Review of Artificial Intelligence Methods for Data Science and Data Analytics: Applications and Research Challenges", *2018 2nd International Conference on I-SMAC (IoT in Social Mobile Analytics and Cloud)*, 2018.
[4] Abhiraj Biswas et al., "Classification of Objects in Video Records using Neural Network Framework", *International conference on Smart Systems and Inventive Technology*, 2018.
[5] Mohana et al., "Simulation of Object Detection Algorithms for Video Survillance Applications", *International Conference on I-SMAC (IoT in Social Mobile Analytics and Cloud)*, 2018.
[6] Pallavi Raj et al., "Simulation and Performance Analysis of Feature Extraction and Matching Algorithms for Image Processing Applications", *IEEE International Conference on Intelligent Sustainable Systems*, 2019.
[7] Yojan Chitkara et al., "Background Modelling techniques for foreground detection and Tracking using Gaussian Mixture model", *International Conference on Computing Methodologies and Communication*, 2019.
[8] N. Jain et al., "Performance Analysis of Object Detection and Tracking Algorithms for Traffic Surveillance Applications using Neural Networks", *2019 Third International conference on I-SMAC (IoT in Social Mobile Analytics and Cloud)*, 2019.

[9] Ayush Jain et al., "Survey on Edge Computing - Key Technology in Retail Industry", *International Conference on Intelligent Computing and Control System s*, 2019.
[10] Ruben J Franklin et al., "Anomaly Detection in Videos for Video Surveillance Applications Using Neural Networks", *International Conference on Inventive Systems and Control*, 2020.
[11] Mohana et al., "Performance Evaluation of Backroad Modeling Methods for Object Detection and Tracking", *International Conference on Inventive Systems and Control*, 2020.