

Breech Face Digital Images Recognition System

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ABSTRACT

The objective of the research was to Design and development of a Breech Face Digital Images Recognition System by developing a digital image comparison algorithm. Combined with deep learning together with database management technology. And to store digital images of the traces of breech, shelling gun and firearm information in the database to link / compare the images of trace of breech digital image to identify the shooting gun. Also using the collecting of documents that involve by developing the algorithm to compare digital image together with database management technology as one of the alternative way to find each gun identity and able to collect the evidence. Moreover, it can also be linked to the offender with a firearm. This research is an innovative research, using the R & D model. The pistol gun used in the study was .38 pistol, shelling gun 25,000 casing. The tools used include Camera, Mobile phones, Computer Matlab, Microsoft Access Database Management. The result found that operation procedures will use Breech Face Digital Images from the field to compare with the shelling gun, gun registration that store in the database with the algorithm that developed to precision over 99% then use the form / method / process / operating system to present and apply in the work operation that can be divided to 4 processes including 1. Image Data Set-up for deep learning, 2. Finding Image Identity, 3. Deep Learning and 4. Apply model from the study to forecast the image

Keywords

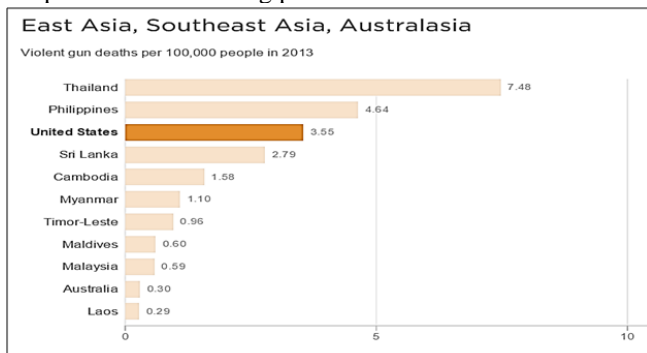
Pistol, Shelling gun, Breech Face Digital Images

Article Received: 6th January, 2021; Article Revised: 26th May, 2021; Article Accepted: 26th June, 2021

Introduction

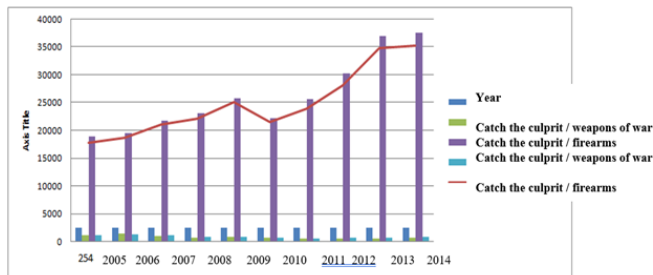
Forensic science is “bringing all fields of science to apply for benefits of law”. The benefits of law as mentioned are legislative benefits in the legislation, benefits of problem solving and disproving in lawsuits to result in the law enforcements and the penalizing start from crime scene investigation, visitation to seize the evidence and photographing until bringing all of the evidences into proof room. All these mentioned processes need the knowledge and abilities of the staffs as well as the budget in operating. Nowadays the doing of justice to the people need to be fast, need to have standard, transparency, good governance and auditable. If lack of any qualifications will effect to the acceptance from all concern or the people and may effect to the punishment of wrong person.

The research from Institute for Health Metrics and Evaluation, Washington University indicated that in year 2016 Asia countries that has the statistic of death from firearm number one is Thailand which has rate of deal by gun at 7.45 persons to 100,000 populations. Next is Philippine which has rate of death by gun at 4.42 persons per 100,000 populations. Which the researcher see that the country that has good study opportunity and good social welfare will cause the low rate of committing crime with gun. On the 22 February 2016, the website of magazine Elite+ (<http://www.eliteplusmagazine.com/home/content/177/8>) has reported that Thailand has highest statistic of death by gun in Asia and more than in United State of America 2 times. And in recently the website Asian Correspondent (<http://asiancorrespondent.com/2016/02/thailand-gun-crime/>) has reported about the reason that Thailand has highest statistic of death by gun and indicated the most motivation are from “face losing” or “business conflicting”. There is focusing on the topic of “face losing” that could be seen as the very small things in many cultures around the world however in Thailand seem like it is very serious to lose face. This could be the thing that should bring to discuss and find the appropriate solution to respond when losing face instead of claim that the protection of face losing is normal in this culture.



Picture 1: The graph show statistic of death by gun in 2013 among Asia countries and The United State of America per 100,000 populations.

Source: Institute of Health Metrics and Evaluation, 2015.



Picture 2: graph show the statistic of firearm arresting 2005 to 2014.

From the study of the researcher found that misfortune that cause life threatening, property and peaceful of the populations in Thailand has one part that is from the criminal who use gun committing crime. These can be seen from statistic of The Royal Thai Police Office from 2005 to 2014. The Royal Thai Police Office able to arrest firearm more and more. The evidence of various cases in present that use the work of forensic science such as firearm information and shelling gun information most are on the papers or the pictures which cannot be connect easily. The investigation of evidence and tangible evidence mainly use eyesight and person always that cause the risk of error and effect to the investigation process to find the real offenders and criminals. The Breech Face Digital Images Recognition System therefore potential to be one of the answers in current situation that consistent of KrachonwongS.(2015) who indicated that the stain of semiautomatic ejector spring of every gun in the breech area has unique identity. The degree and interval of the stain of ejector spring in each brand and each series have statistic significantly both different and not different. That is consistent of the study that support the investigation and comparing existing information to be able to connect to the gun that use in crime, help the expertise to work faster and more accurate instead of using only eyesight. The law enforcement department able to prosecute and proving correctly, comfortable and faster. By applying technology to benefits the national has good impact to life security, life being and social peaceful and overall economic stability. The officer who are full time worker, mid-level management and high level management able to bring the processed data to apply in their work operation or use as the idea to form the policy of their department and including private sector or other government sectors also able to bring these data to use according to the law that allows every segments to use these data in order to save the budget that Thailand has to import the evidence proof machine which has high cost from oversea.

So this research therefore interested to develop Breech Face Digital Image Recognition System by connecting/comparing data of the gun and data of the picture breech face digital image by using technology in indicating gun identity which from this study will gain innovation that benefits to investigation job and Thai forensic science job.

Research Propose To design and develop Breech Face Digital Image Recognition System by developing the algorithm compare digital image and combine with the deep learning together with database management technology and apply the model from the study to forecast the images.

Research Methodology

The study has done by collected the concern documents. The researcher has collect many of documents both the theory of the involving research about information of the strain of breech and gun information in order to determine the research framework, study the present and past involved work system, literature review through the research involved. The researcher has studied work system both in the past and present that concerned together with tools, strain of breech data and gun data that the evidence proof by algorithms center compare digit image together with database management technology as one of the alternative way in finding the identity of each pistol gun and able to collect the evidence such as breech face digital image both image and digital data in the database to connect/compare image of the strain of breech in determining gun identity that use to shoot. Moreover, these data use to connect to the gun registration to find the criminal by using the database management technology. This research will create the building of database to collect the data of strain of breech and data of gun in the network server. The process emphasizing on comparing the strain on the breech by using algorithms to connect with the shooting gun. When able to identify the shooting gun will able to bring the data collection in the database to connect with the data to identify the criminal. The part of client machine will able to pull the data from the network server at all times.

In the part of in-depth data that can be indicated that the strain on the breech appears from which gun, if there is never shoot and never collect the breech face digital image will need to bring those gun to shoot around 3 times (Pro. PhD. Pitak Thammavarin, gun proving system from bullet image) minimum and take the picture of the strain at breech to collect in database and bring the case evidence that is the breech from field to compare and able to linked with the shooting gun also able to use this gun data link to the offender with firearm.

Research Framework

Breech Face Digital Image Recognition System also included the information that use in examination and information favor from the firearm and ammunition sub-Division, Central Police Forensic Science Division 7. Which know that the pistol used to committing crime the most is .38. Therefore used the information from shelling gun that shoot from this type of gun as the part of examine. The information management will use the type of relational database structure.

Tools

1. Tools used in the research including .38 Pistol, Breech Face Digital Image for 25,000 shots, Camera, Mobile Phone, Computer and Software.
2. Use of Matlab Language to developing the system by connecting with the database management of Microsoft Access.

3. The developed program able to Data Saving, Data Display and Logout Data Management by having the details as follow 1) Data Saving, able to save the data of firearm and breech face digital image data which can be add, store, search, cancel, adjust and delete all data that happen by right and opportunity. 2) Data Display, able to display the result of shooting gun, show display compare with breech face digital image. 3) Data Management, able to Setup the system, Prepare Training System, Copied information, pull the copied of information to use whenever there is damage in the system.

4. Able to bring the digital image data of the trace at the breech face from filed to compare with image of trace at the breech face in the database in order to identify the identity of the shooting gun as well as able to linked to the offender or the criminal. Analyze and present the result by analyze the experimental result to conclude and build relationship of data in descriptive way.

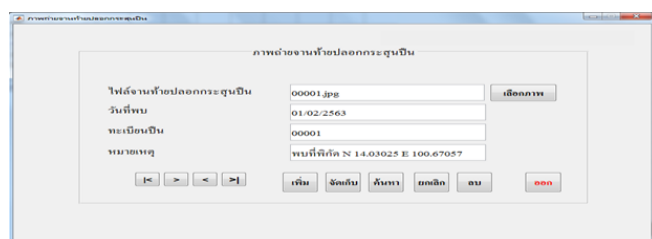
Research Result

1. Design and Develop the Breech Face Digital Image Recognition System by developing the algorithm compare digital image combine with Deep Learning together with Database Management Technology and apply model from the study to forecast the image and found the information below.

2. From the studied found the need of setting up the menu, setting up the form of data display management and prepare the deep learning data of image forecasting. Able to present the process and method to developing the algorithm compare digital image.

3. The process and method to developing the algorithm compare digital image can be divided to 4 processes a follow. 1. Image Data Set for Deep Learning 2. Identify Image Identity 3. Deep Learning 4. Use model from the studied to forecast the image.

1. Image DataSet for Deep Learning to save Breech Face Digital Image into the table to store the database.



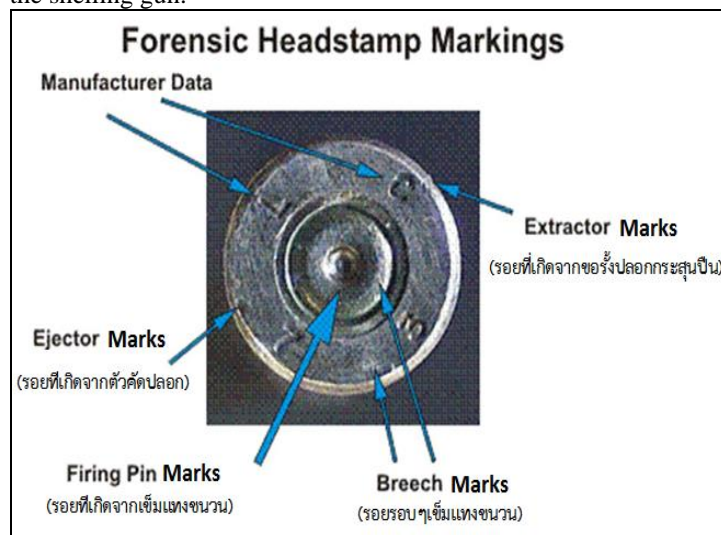
Picture 3: Table store in database



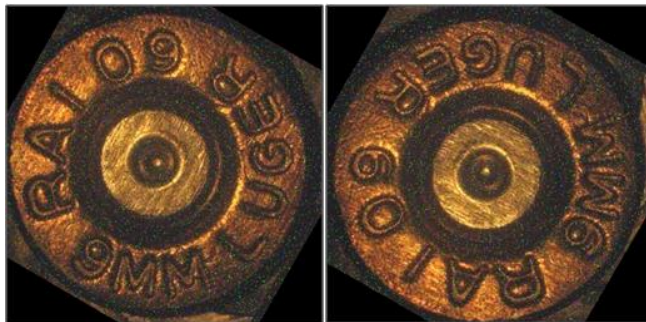
Picture 4: Sample of Breech Face Digital Image store in database

2. Image Identity

From the image there will be data recording of Breech Face Digital Image into the database which include file name of Breech Face, date found, gun registration and note. The recoding of this information after select the image the system will start to investigate. However if the system found that the image is not the breech face digital image, system will then alert that this is not the breech face digital image which this research will input the image total 200 image of the shelling gun.



Picture 5: The trace on Breech

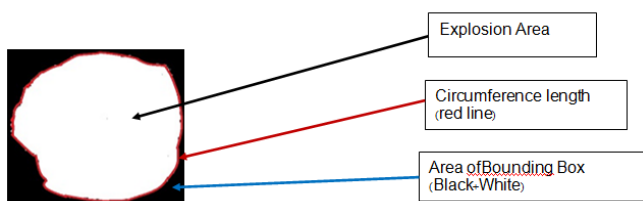


Picture 6: Sample of Breech after add Noi

3. Deep Learning

Whenever gun shooting out, the mark will show up as in the picture above. The researcher bring all value to find the identity of the image from all marks to use in the deep learning process by pulling the image and all data from the database table that consolidated in the data image set process which has the total of images 200 images and then rotate to 0, 15, 30, 45 and 60 degrees. Which each rotation of the single degrees will put Noi types Gaussian, Salt & Pepper and Speckle. Each Noi will use density at 4%, 6%, 8%, 10%, 12%, 14% and 16%. These process give the number is sample at 25,000 samples which has process and method after reading the value as follow in the next page.

- Adjust the image to be parallel with the make from explosion in the horizon line
- Adjust the image brightness to be appropriate with the working environment
- Copy the circle in the breech face part
- 3 Resize 500*500
- Convert the image to Binary
- Eleminate Noise
- Find the edge
- Cut the edge
- Select the useful part
- Deep learning consider from image at the back



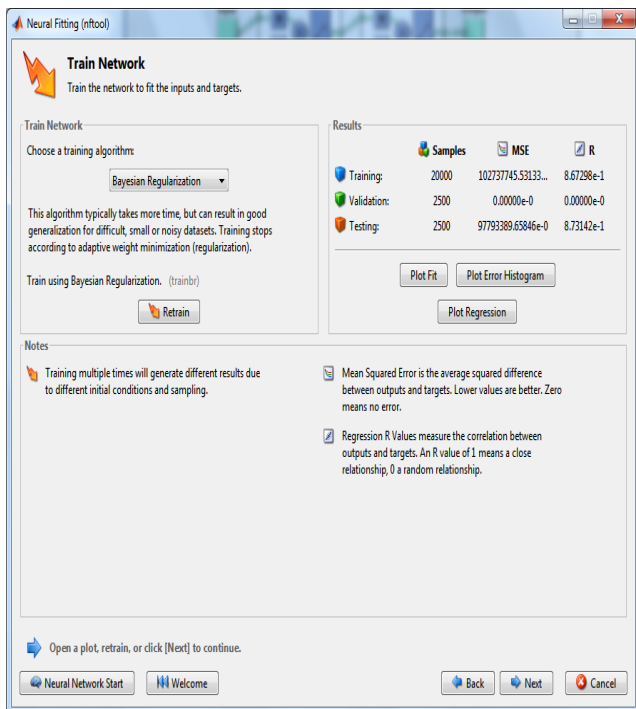
Picture 7: Show image identity that were used

Values that brought to Train. Consider from Input and Target

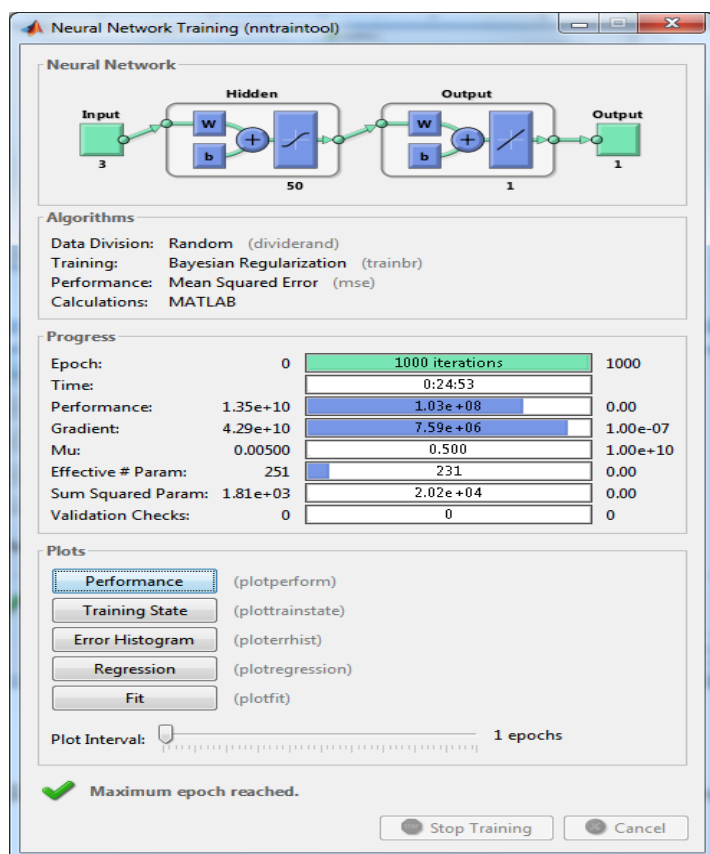
Table 1 Show values the brought to Train.

No	Breech Face Digital Images Files	inputs			target	
		Explosion Area x1	Bounding AreaBox x2	Circumference length x3	Explosion Area y	Breech Face Digital Images Files
1	00001.jpg	67199	92868	134412.40	67834.980	00001.jpg
2	00001.jpg	72508	101616	145039.31	72302.308	00001-00-1500.jpg
3	00001.jpg	80235	103800	160507.96	77551.483	00001-00-3000.jpg
4	00001.jpg	92529	113533	185896.37	78938.806	00001-00-4500.jpg
5	00001.jpg	91285	107917	184343.32	68892.419	00001-00-6000.jpg
6	00001.jpg	67446	94176	134915.12	68427.049	00001-02-00GS.jpg
7	00001.jpg	68503	93808	137022.75	69331.100	00001-02-00SK.jpg
8	00001.jpg	68169	93808	136352.82	69026.553	00001-02-00SP.jpg
9	00001.jpg	68066	95371	136152.78	69136.547	00001-02-15GS.jpg
10	00001.jpg	71584	100050	143189.49	72183.282	00001-02-15SK.jpg
11	00001.jpg	71623	100572	143265.44	71657.441	00001-02-15SP.jpg
12	00001.jpg	85894	110716	171876.97	78089.304	00001-02-30GS.jpg
13	00001.jpg	78778	102465	157605.50	77601.301	00001-02-30SK.jpg
-
-
25000	00200.jpg	85410	108360	170871.67	74758.714	00200-16-60SP.jpg

When chosen the 3 identities including Explosion area, Area happened from height BoundingBox* width BoundingBox which herein call BoundingBox and Length of circumference from explosion area as inputs and explosion area as targets which has already Loaded to work space by access to the Matlab program in command window input the order nnstart and get the result as in the image. Import the Breech Face Digital Image for 200 cases into database such as file name of Breech Face Digital Image, Date found, Gun registration and notes and then adjust to 0, 15, 30, 45 and 60 degrees and put Noi types gaussian, salt & pepper and speckle each Noi will use density at 4%, 6%, 8%, 10%, 12%, 14% and 16% to get the sample amounts total at 25,000 samples. Then extract the identities of each images from the marks to use in the Deep Learning process which has chosen Explosion area, BoundingBox area and Length of Circumference to process. Has set that explosion area, BoundingBox area and length of circumference are the input data and explosion area is the target data and determine hidden layer size 1 - 50 by using Matlab, use order nnstart which nnstart will open the window that has button for Artificial Neuron Network recognition model installation, cluster and time set. Beside that also has the link connect to sample data set and others useful data to start use program Deep Learning. In the operation with 25,000 samples by 80% are Training, 10% are Validation and 10% for Testing which result as the following pictures.



Picture 8: Show the sample by 80% are Training, 10% are Validation and 10% for Testing



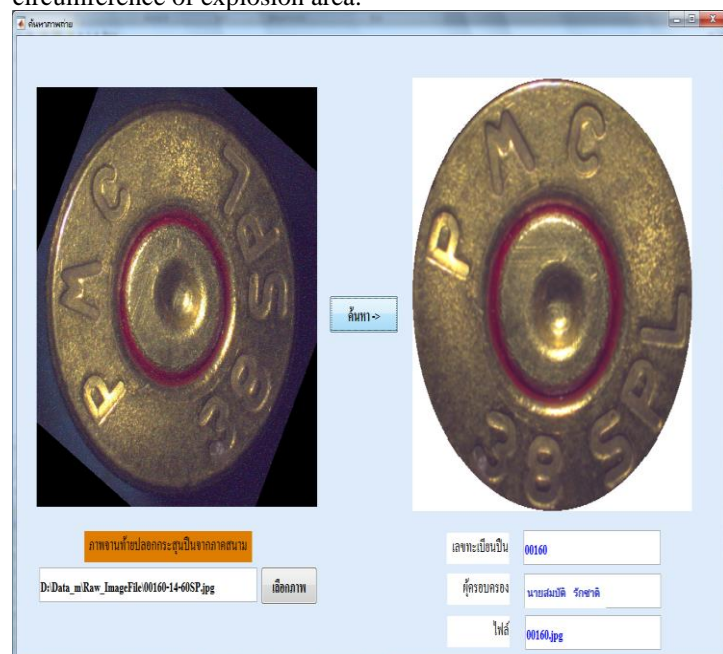
Picture 9: Show the sample by 80% are Training, 10% are Validation and 10% for Testing

4. Apply model from learning to forecast the image

From the values of 3 inputs such as explosion area, length of circumference and BoundingBox for total 25,000 samples, divided into Training 20,000 samples, Validation 2,500 samples and Testing 2,500 samples. The 50 Hidden numbers or the number of cells in the hidden layers that apply to train. From the Artificial Neuron Network (ANN) found that the system will stop at 1,000 Epoch, time used 24.53 minutes and the results from training get the value below.

Mean Squares (Training = 102737745.53133, Validation = 0.00000e-0 and Testing = 97793389.65846e-0). Regression value (Training = 8.67298e-1, Validation = 0.00000e-0 and Testing = 8.73142e-1) which brought to Performance value = 1.03e+08 Gradient = 7.59e+06.

To brought the learning model to forecast using the Y formula = results.net ([x1; x2; x3]) whereas Y = targetx1 = explosion area x2 = BoundingBox3 = Length of circumference of explosion area.



Picture 10: Show the image comparison of shelling gun from learning model to forecast

Discussion

Design and develop Breech Face Digital Image Recognition System by developing the algorithm compare digital image and combine with the deep learning together with data management technology, SukancharikaBoonmatham, JirawatKaewkosol and AekapongThonhtae (2016). The operation in present day has brought Information system, Computer network and Internet communication in coordinating the corporation to create the opportunity and the more competition. The information system therefore very important and necessary in operation of the organization or other units. To brought the model from the study to forecast the image found that there must have the menu preparation, preparation of management performance data saving form and deep learning data preparation, Q. Wu, Y. Liu, Q. Li, S. Jim and F. Li (2017) is the order set that created to the learning of computer by this order set will make the system able to analyze the big amount of data results that try to learn the method of data replacing

effectively. The principal of deep learning is the artificial neural network: ANN that is the many level of node and use the parallel processing to enable the big amounts of data processing that support the machine's learning to able to results in making decisions and more effective forecasting. The forecasting of pare of image able to present the processes and methods to develop algorithms preparing digital image, Hongboonmee N and Jantawong N. (2020). Beside that JirasakThongkla, (1999) said that there are many form and style of photographing, each style have different characters depending on the technique and the photography methods. Which the learning process of photography method that has been said must use the technique and studying of photographing methods. The part of database build up to connect/prepare the marks of breech face digital image to identify the shooting gun identity moreover also able to link to the offender with firearm by finding the identity from breech face digital image mark that has been selected and consistent with the database management idea of Kiattiwat N (2014) who has mentioned that the collection of same types of data that has relationship, orderly storage, high safety from lose, easy to call for use and easy to adjust the data will include with 4 factors as follows 1) Hardware such as suitable computer and communication instruments. 2) Software for manage data and create information in the form of website. 3) Data must have suitable quality, must have accuracy to needs and desires, clearly and compact. The last factor is 4) Human researches including creator and user. The studied of Explosion areas, Length of circumference and BoundingBox areas by Metkarunchit T. and Charoenpojvajan K. (2020). The explosion area, BoundingBoxareas expand to the distinguish attributes that interesting will put to Region Proposal Network: RPN to find the Region of Interest: ROI that supposed to be the most object in the image by using the filter scan into the attributes chart that gain from anchor areas by using anchor box that has different size and scale to infers the location of bounding box that close the object of ROIs and length of circumference to pass the process of deep learning by using the Matlab Language Tool which TuntrakoolS (2018) mentioned that it is the very famous computer program applying to various jobs and professional fields. This is because the easy to write the program that very similar to human language especially there is the continuous of development and improvement to make it easy to use. There are the additional of many various help to get more understanding and able to fix the error easily such as message and box that show the error possible to advise the guideline of fixing in many procedures. The function of mouse pointing and show pop-up, the pop-up message in the syntax form and using others functions support during write the program to be more correct and easier. The MATLAB has been applied to use in academic including researching in many fields of study such as Scientific, Engineering, Medical and Financial. The studied generate model or algorithm which able to research breech face digital pare of image which shoot from the same gun according to the hypothesis of the research that is, Beech Face Digital Image Mark and the gun data able to link/compare to identify the identity of gun. Also can be connect with the offender of

firearm by using algorithm together with data management system.

Suggestion

The suggesting in term of policy the concern division should support and plan in the development of forensic science to be the international standard. The acceptant of technology, the lesson learned from the successful countries in forensics that has technology and the progressive knowledge. Also now still lack of specialist therefore the researcher which to offer the development both researches and human resources that will apply this research to use in parallel together by the budget supporting in expanding the training institution and forensic science research to comprehensive in all areas by having necessary tools and instruments in completing the forensic science.

References

- [1] SukanchalikaBoonmatham, JirawatKaewkosol and EakapongThongtae, (2016) Development of a Management Information System of Research Database of the Faculty of Information Technology at Phetchaburi Rajabhat University, Journal of Innovation Technology Management, 3(2), 39-45
- [2] JirasakThongkla(1999). Photographing 1. Petchburi: Rajabhat Petchburi University,
- [3] Kiattiwat N (2014) Building Up Information System for Physical Development of Kampang-Ngam and Hua-Fai Communities, Mueang District, Chiang Mai Province, Journal of Environment Design 1(1), 33-44
- [4] KrachonwongS.(2015) The study of ejector mark on breech face of cartridge case from semi-automatic pistol Veridian E-Journal, Science and Technology Silpakorn University, 2(1), 101-111
- [5] Hongboonmee N and Jantawong N. (2020) Apply of Deep Learning Techniques to Measure the Sweetness Level of Watermelon via Smartphone, Journal of Information Science and Technology 10 (1), 59-69
- [6] Baffling statistics fail to hide Thailand's worrying gun crime problem, Asian Correspondent, 16-02-2016.

- [7] THAILAND HAS A HIGHER RATE OF GUN-RELATED DEATHS THAN THE US, Elite+, 20-02-2016. From: <http://www.eliteplusmagazine.com/home/content/177/8>
- [8] Tuntrakool S (2018). Matlab Applications, *Journal of Industrial Education*, 17(1), 1-6
- [9] Metkarunchit T. and Charoenpojvajana K. (2020) Detection of COVID-19 using Deep Learning with CT Scan Images *Journal of Engineering and Technology*, 8-17.
- [10] Q. Wu, Y. Liu, Q. Li, S. Jim and F. Li (2017) "The Application of Deep Learning in Computer Vision," in *Proceeding of 2017 Chinese Automation Congress (CAC)*, Jinan, China, 2017, pp. 6522–6527