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Research Article

Deep Learning Algorithm Design for Discovery and Dysfunction of Landmines

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Abstract:

Deep Learning is a cutting-edge technology which has a noteworthy impact in the real-world applications. The multi-layer neural nets involved in the blueprint of deep learning enables it to deliver a comprehensive decision-making system with quality of "think alike human cerebrum". Deep Learning assumes an essential part in various fields like horticulture, medication, substantial business and so forth. Deep Learning can be well prompted in the remote sensing applications especially in perilous military applications. The location of land mines can be detected using a deep learning algorithm design technique aided with distinctive machine learning tools and techniques. The intelligent system designed by the deep learning process involves a massive dataset including the assorted features of the landmines like size, sort, dampness, ground profundity and so on. Incorporation of Geographical Information System can give a prevalent statistical analysis of the varied landmines. The multiple layers present in the deep learning neural schema may increase the feature extraction and the knowledge representation through increase in the complexities of landmines' input sets. The likelihood of brokenness of landmines can be increased by the utilization of deep learning prediction model which enormously helps the survival of militaries, creating a social effect.

1. Introduction

Deep Learning finds its origin from Machine Learning which deals with various methods based on learning data representations [1-23]. Deep Learning is an innovative and new area of Machine Leaning, which has the objective of achieving one of its main goal i.e.) Artificial intelligence. In fact it is hyperbole to say that, across a wide range of difficult problem domains Deep Learning is based on learning data representations [24-40], and it is opposed to task specific algorithms. Deep learning is broadly classified into two types namely, supervised learning and unsupervised learning. Some representations in deep learning are loosely based on information processing [13] interpretation and other communication patterns [10] in living nervous system. An example to this technique is neural coding. Deep Learning working architectures are usually built from neural networks. Deep neural networks are evolved from artificial neural networks. Deep neural networks have many numbers of hidden layers between the input and output layers. Deep learning neural networks architectures generates composite models where the objects [12] are expressed as a compositional layer of primitives. The extra layers enable feature composition from the lower layers. Deep learning generally includes many variants of few basic approaches. All architectures in deep neural architecture have found its success in many specific domains. But it is not possible to compare the performance of multiple architectures, unless these architectures are evaluated on the data sets of same type [3]. Two major common issues in Deep Neural Networks are over fitting and computation time. Due to the added layers of abstraction DNNs are often prone to over fitting. Some of the applications of Deep learning is speech recognition [1] and vision recognition [14]. The principles of elevating “raw” features over hand-crafted optimization were the first exploration that created history in the field of deep learning. They are accepted by this technique Deep Learning is achieving massive results. It’s true that we find lots of excitement around artificial intelligence, machine Learning and Deep Learning. This platform also gives an amazing opportunity to power up our brains in the field of powerful tech. Deep Learning finds its essential part in almost all the upcoming technologies. Deep Learning also finds its application in some fields like horticulture, medication, substantial business and so forth. Deep Learning has also stepped in geosciences and remote sensing community and has been a major part in remote sensing big data analysis. Key bottlenecks and potential directions are used as guidance in sensing RS data. Deep Learning can be well prompted in the remote sensing applications especially in perilous military applications. The RS technology has been implemented in the detection of landmines. Using a Deep Learning algorithm design technique aided with distinctive Machine Learning tools and techniques exact location of landmines can be predicted and located with a great accuracy. A flying drone and a drone-controlled robot find its partnership in the detection and dysfunction of landmines. Based on certain assumptions the flying drone transmits the location of landmines to the detector robot, which in turn detects the exact location of landmines and diffuses it. Since Deep Learning is entirely based on neural layers, the Deep Learning algorithm design strategy has been used in the detection and dysfunction of landmines through many layers. Further variety of Machine Learning algorithms combined with Deep Learning techniques are implemented in various layers for the detection of landmines. The detection and diffusion process of landmine is illustrated and implemented using different algorithms.

2. Related Work

Landmines are dangerous explosive material that is automatically triggered when it comes in contact with a person or vehicle. Landmines are generally buried within 10 – 15cm of the earth’s surface or they are just laid above the ground. At present there are nearly 600 different types of landmines and they can broadly into two categories, antipersonnel (AP) landmines and antitank (AT) landmines.

Antipersonnel landmines are explosive device that are designed in such a way to injure or kill a person. They a further classified into three categories, EXPLOSIVE BLAST EFFET AP LANDMINES: These are designed in an odd manner with bright colours and so it seems irresistible to children. These are the most common type of landmines and they are at a cost of $3 each. Afghanistan ranks first in landmines and nearly ¼ part of the country is filled with landmine areas. FRAGMENTATION AP LANDMINES: These landmines have metal casings that are designed to rupture into fragments when the mines are detonated. On explosion it covers an area of 50 meters. Legs, stomach and chest of humans are damaged which even may lead to death. BOUNDING AP MINES: Perhaps the deadliest of all antipersonnel land mines and are commonly called as “Bouncing Betties” These are more sensitive and they generally triggered by as little as 1.5kg of pressure on trip wires and direct pressure. It covers an area of nearly 100 meters or more and causes severe injuries and death. Antitank (AT) Landmines are capable of destroying tanks and other vehicles. They have heavier explosive charge of 14kg and are much larger when compared to AP mines. Antitank Landmines are big killers and causes severe damages on explosion.

Before the advent of deep learning and other technologies, the detection and dysfunction of landmines was complex. In traditional method there were no particular algorithms or techniques in detecting the exact location of landmines. Humans manually implemented certain techniques in detecting the landmines. I) Probing the ground – Years ago, by probing the ground with a stick or bayonet the location of landmines was detected. Soldiers in military camp were trained to poke ground slightly and gently with a bayonet. This method will end the soldier’s life when he makes one wrong move. II) Trained dogs – Military dogs were trained to sniff out vapours coming from the landmines. The explosive ingredients inside the landmines emit certain vapours which helps the dog in detection. III) Metal detectors - Metal detectors have certain limitations in its ability to find landmines, because many landmines are made of plastic with only a tiny bit of metal. Other chemical methods can be also used in the detection of landmines. But we cannot detect and locate the exact location of these landmines which is a major drawback in these methods. Also, careless implementation of these methods may lead to explosion of landmines.

The landmines used today are entirely from different from the mines of the World War II era. The landmines used World War II required physical contact and relied on blast effects. At present the landmines are triggered not only by pressure, but also by magnetic, seismic, or other advanced fuzzes. Colombia ranks second in victims from landmines. If a person steps on a landmine, then we must be dysfunction to prevent it from exploding. There is no technical method in the dysfunction of landmines and it must be diffused manually. Nearly 12% military soldiers lost their life due the careless way of diffusing these landmines. Hence it better to stay away from landmines and prevent it from explosion. People must look for sign boards which displays ‘caution message’ regarding landmine areas and it is better to stay away from these areas. However, landmines are used in defending military positions and socioeconomic targets [25]. The victim rate of landmines is enormous. Nearly 1 million people have been killed and maimed by anti-personnel landmines. 26,000 people a year becomes a victim and 70 people a day or around and one person every fifteen minutes loses their life as some mines in remote areas are not diffused. Hence a solution must be found for detection and dysfunction of landmines to reduce death rate. Many researches have been done on Ground penetrating RADAR (GPR) to locating the landmines. By the implementation of Deep learning algorithms along with the Machine Learning techniques tools and techniques the exact location of landmines can be detected and diffused.

3. Deep Learning Algorithms

Most popular Machine Learning algorithms and techniques practiced in the implementation of Deep Learning are discussed in this section. These algorithms can be broadly classified into Supervised Learning, Unsupervised Learning and Semi-supervised Learning. A modern update to Artificial Neural Networks that exploit cheap computation is Deep Learning. They are mainly built based on more complex neural networks and mostly they follow semi-supervised learning problems where very little labelled data are held by large datasets. There is no doubt that the artificial intelligence/ machine learning/ deep learning are gaining more popularity in past couple of years. Now let us discuss various Deep learning and Machine learning algorithms that are used in the detection and dysfunction model of landmines in detail. Now let us discuss various Deep learning and Machine learning algorithms available.

3.1 Gaussian Mixture Model

Gaussian mixture model is a probabilistic model extremely used for representing the subpopulations within an overall population that are normally distributed. This model does not require to which subpopulation a data point belongs to and this model allows automatic learning of sub populations. This comes under the type of unsupervised learning since the subpopulation assignment is not known in this algorithm. It’s given in the figure 1. In general Gaussian Mixture Model has more than two components. The canonical problem in modelling data with Gaussian Mixture Model is estimating the parameters of the individual normal distribution components. A hint to find if the data follows mixture model is that the data looks multimodal, i.e. in the distribution of data there is more than one ‘peak’. Normally many simple distributions are unimodal, a way to model a multimodal distribution would be to so assume that it is generated by multiple unimodal distributions. Many of the theoretical and computational benefits of Gaussians models are maintained by GMMs. Gaussian models make them practical for efficient modelling of very large datasets. A Gaussian mixture model can be parameterized by two types of values, the mixture component weights and the mixture component means and variances/covariance.

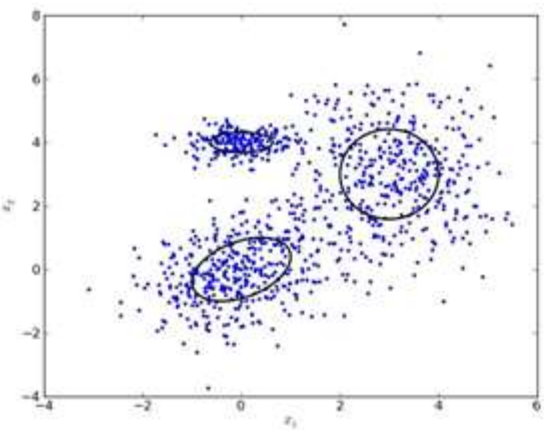

Figure 1. *Gaussian Mixture Model.*

3.2 Decision Tree Classification

Decision tree classifier is a systematic technique to build classification [15] models from a set of input data given. It is one the most simple and effective deep learning algorithm that brings a complete conclusion based on different layers of comparisons and evaluations. It is one of the types of solving classification problems. To identify the model, each technique adopts a learning algorithm that fits the best relationship between the set of attributes and class label of the input data. Building predictive model that accurately predicts the class labels of previously unknown records is the key objective of learning algorithms. Decision tree classifier is a simple and widely used classification technique. Straightforward idea is applied to solve the classification problem. Decision tree classifier always poses a series of orderly crafted questions [20] regarding the test record's attributes. Whenever it receives an answer, a follow-up question is posted until an exact conclusion about the class label of the record is finally reached. The Decision tree classifier generally organizes series of multiple test questions and conditions. The multiple test questions and conditions are organized in a tree structure. In the decision tree classifier, the root and internal nodes contain attribute test conditions to separate records that have different characteristics. All the internal nodes in the decision tree classifier are assigned with a class label Yes or No. One of the exclusive algorithms of Decision tree classifier is the Hunt's Algorithm. Hunt's algorithm has a recursive fashion by partitioning the training records into successively purer subsets. To determine how well a test condition performs, we need to compare the degree of impurity of the parent before splitting with degree of the impurity of the child nodes after splitting. The larger their difference, the better the test condition. The measurement of node impurity/purity is:

1. Gini Index
2. Entropy
3. Misclassification Error

3.3 Neural Network

Neural networks are a beautiful biologically-inspired programming paradigm that enables the computer to learn from observational data. Neural networks [4] and deep learning provides the best possible solutions to the majority problems that occurs in image processing, image recognition, speech recognition [2] and natural language processing [7,8,19,24]. An artificial neural network (ANNs) is also called as connectionist systems. These are computing systems inspired by the biological neural networks that behave like a human brain. These types of systems learn to perform tasks by considering the examples only, and they do not follow task-specified programming. An Artificial Neural Networks is mainly based on the collection of multiple connected units called as artificial neurons. These artificial neurons are analogous to axons in a biological brain. Some of the distributed systems like Hadoop's MapReduce paradigm eliminate the need of super computers in handling the massive calculations neural networks require. In these systems we can just spread the job out across clusters of commodities. Non-linear patterns can be easily identified by using the neural networks. In direct, one-to-one relationship the networks identify the patterns [16] between combinations of inputs and a given output. It is a fact that artificial neural networks are working like human brain, but it typically contains between a few thousand and a few million neurons compared to the 85 billion or so neuron that are present in the normal human brain. The Artificial neural network consists of three layers namely,

Input layer: The neurons that do nothing and just receive the data and pass it on are present in this layer. The number of features in our data set must be equal to the number of neurons in the input layer.

Output layer: The total number of nodes in the output layer is based on the type of building model. In case of classification system, there will be at least one node for each type of available label. But in regression system there will be just a single node that puts out a value.

Hidden layer: Hidden layer is placed between the input and output layer; this layer holds much number of neurons. The number of neurons in the hidden layer is based on the number of neurons in the input and output layers. The nodes present in the hidden layer apply transformations to the inputs before passing them on. Since these nodes are well trained, the outcome from these nodes is more predicative.

3.4 Support Vector Machine

Support Vector Machines (SVM) that are supervised learning [9] models in machine learning [5] that are associated with learning algorithms that analyze data used for the purpose of classification and regression analysis. Consider a set of training examples, each marked as belonging to one or other of the two categories of Support Vector Machines. An SVM training algorithm builds a model that keeps on assigning new examples to one category [6] or the other and the result of this assigning strategy leads to Probabilistic binary linear classifier. Some of the Probabilistic binary linear classifier such as Platt scaling are used in the Support Vector Machine. Some examples such as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible can be represented using Support Vector Machine algorithm. Generally, SVMs can perform only linear classification, but in some cases SVMs are capable of performing non-linear classification using what is called the kernel trick. Kernel trick implicitly maps their inputs into high-dimensional feature spaces. In case if the data are not labelled, then there will be no chance of supervised learning and unsupervised learning [21] is required here. The technique of Support Vector Machine can be improved by using a clustering algorithm called support vector clustering. Support vector clustering method is used in industrial application either when data are not labelled or when only some data are labelled as a processing for a classification pass. Support Vector Machines finds its application classification of images. Few experimental results show that SVMs achieve significantly high search accuracy that traditional query. The SVM is used in the reorganization of hand-written characters. Biological and other branches in science uses SVM algorithm. Permutation tests based on SVM weights have been suggested as a mechanism for interpretation of SVM models. There are some drawbacks in the SVM model that includes, i) it requires full labelling of input data. ii) SVM stems from Vapnik's' theory avoids the estimation [17] of probabilities on finite data and this is called as Uncalibrated class membership probabilities. iii) In case of two-class tasks, SVM is only directly applicable. Therefore, few algorithms that reduce the multi-class task to several binary problems have to be applied. iv) Interpreting the parameters of solved models are difficult in SVM. This algoirthm is shown in the figure 2.

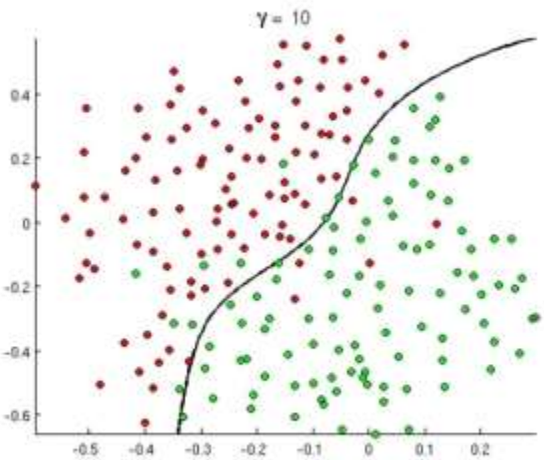

Figure 2. *SVM Algorithm.*

3.5 K-Nearest Neighbour Algorithm

The next algorithm is the k-nearest neighbour algorithm. It is shown in the figure 3. The KNN model representation covers the entire training dataset. It is the simplest way of detecting the most nearby position of the pattern [18] form the current location. KNN has no model other than sorting the entire dataset, thus the need of learning is eliminated in this model. K-d trees are used in the efficient implementation of these models that can store data using both simple and complex data structures. In k-d trees the entire dataset is stored and hence we have to think carefully about the consistency of the training data. It would be a good idea to curate it, update it often as new data becomes available and remove erroneous and outlier data. Predictions are made for a new instance (x) by searching through the whole training set for the K most similar instances and summarizing the output variables for those K instances. For regression this might be the mean output variable, in classification this might be the mode class value. To determine which of the K instances in the training dataset are most similar to a new input a distance measure is used. In case of real-valued input variables, the most popular distance measure is Euclidean distance. Euclidean distance is calculated as the square root of the sum of the squared distances between a new point (x) and an existing point (xi) across all input attributes j.

$$Euclidean\ Distance\ (x, xi) = sqrt(sum((xj - xij)^2)) \qquad (1)$$

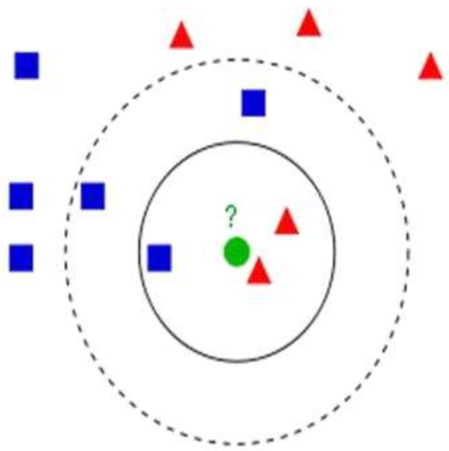

Figure 3. *k-nearest neighbour algorithm.*

3.6 Dimensionality Reduction

Dimensionality reduction in machine learning and statistics is the process of reducing the number of random variables under certain considerations, via obtaining a set of principle variables. Dimensionality reduction can be divided into feature selection and feature extraction. For high-dimension datasets dimensionality reduction can be performed prior to applying a K-nearest neighbour's algorithm in order to avoid the effects of the curse of dimensionality. Using some techniques such as principal component analysis (PCA), linear discriminate analysis (LDA), or canonical correlation analysis (CCA) the feature extraction and dimension reduction can be combined in one step. In machine learning this process is also called as low-dimensional embedding. For very high datasets such as when performing similarity search on live video streams, DNA data or high-dimensional time series fast approximate K-NN search using locality sensitive hashing and random projection techniques are used. The dimensionality reduction technique that sometimes used in neuroscience is maximally informative dimensions, which finds a lower dimensional representation of dataset such that as much information as possible about the original data is preserved. Some of the major advantages of dimensionality reduction technique is that, it reduces the time and storage space that are required for the data input. Next is, removal of multi – co linearity improves the performance of the machine learning model. Then it becomes easier to visualize the data when reduced to very low dimensions such as 2D or 3D.

4. Proposed Work

To eliminate the defects of traditional methods and also to control the death rate, the detection and dysfunction of landmines can be implemented via Deep Learning algorithms and machine learning tools and techniques. As an overview, some of the algorithms such as Support Vector Machines (SVM) are used to detect and locate exactly landmine's metal body by eliminating other metal substances such as nail, knife, steel rod etc. Clustering algorithm is implemented for the assumption of landmine areas by the flying drones. The detector robot locates the nearest landmine's location by implementing the k-nearest neighbour's algorithm and diffuses it. Based on the size, shape and type, the dysfunction methods for each landmine varies from one another. Dimensionality reduction algorithm is implemented for analysing the most suitable dysfunction method for the landmine detected. Neural networks [11] implementation makes the detector robot to think like a human brain and diffuse the landmine. These are some of the algorithms used in detection and dysfunction of landmines. Other Deep learning and Machine learning tools and techniques are used in this method. Radio frequency (RF) is adopted in controlling the transmission and receiver between the flying drone and detector robot remotely. Ground Penetrating Radar (GPR) is a geophysical instrument which is non-destructive in nature and uses radar pulses to image the subsurface in real time. Utility locating is the process of accurately surveying and plotting the exact location and depth of the detected landmine. Radio detection RD8000 and RD4000 electromagnetic locators are used by the detector robots in locating the exact location of landmines underground. Image processing in Deep Learning make the detector robot to think like a human and provides a machine vision of analysing the various factors of landmines and helps in diffusing it. By using these tools, the landmines can be located and diffused.

Flying drone commonly known as unmanned aerial vehicle (UAE). Drones are similar to aircraft without human pilot and can be operated either under remoter control by a human operator or by onboard computers autonomously. Based on the design of the flying drone and the country in which it is operated, the maximum height a drone can fly is estimated. Normally in India, the maximum height a drone can legally fly is 400m above the ground level and it can fly only in places that aren't no-fly zones. Military drones can fly fairly at a height of 10,000 feet above the ground level. To reduce weight and increase manoeuvrability, the drones are designed with light composite materials. These light composite materials help the military drones to fly at extremely high attitudes. Drones are well equipped with technologies such as infra-red cameras (military UAV), Global Positioning System (GPS) and laser (military UAV). Remote control system or a ground cockpit is used in controlling the drones. Drones are in wide variety of sizes and drones of larger size are used for military purpose such as Predator drone. All sensors and navigational systems are present at the nose of the unmanned aerial vehicle. This drone is made to fly at a height of 400m to detect and locate landmine area based on assumption.

A detector robot is used in detecting the exact location of landmines. Radio detection RD8000 and RD4000 electromagnetic locators are used by the detector robots in locating the exact location of landmines underground. For emergency stop position of the robot Atmega 32 microcontroller is used. To regulate the movement of the robot and to interface the RF communication device Atmega 128 is used. The aim behind the construction of detector robot is that it is capable of sensing in all directions to detect the presence of explosive landmines. The location of landmines is detected by using a sensor called proximity switch. A high frequency electromagnetic field is generated by using a coil. The rate of current flow increases when the target gets closer. Hence it stops the oscillation. A sensor detects this change in signal and the detected signal is sent as output. The sensing distance of the detector robot is estimated as 30mm. For further processing, the resultant signal is interfaced to the microcontroller. The output voltage at the proximity sensor will be recorded as 4.95 V in absence of explosive landmines. Wireless infrared camera is placed in the detector robot for capturing images and for image processing. To transmit and receive video or image information, the camera is operated with a frequency of 2.4 GHz. The videos and images are captured by the camera and then transferred to the control room for analysis. These wireless cameras are capable of transmitting video information up to ‘91’m. The robot also consists of powerful magnets such as Neodymium magnet for lifting and removing the magnets for the soil surface.

Communication radio frequency technology is a wireless technology that emits electromagnetic signals for communication between the flying drone and the detector robot. The propagation of the signal speed is matched with the speed of light. In the transmitter section, Radio frequency communication is mainly adopted in communicating with the developed robot. Command signals are transmitted to the robot which makes it to turn left, right or move front or backward. Many hardware components are used for the implementation of the stimulated work to enable the transmitter unit. HT12E encoders are used to interface the RF transmitter to the path controlling switches. Each switch is assigned with an address and data input. RF transmitter is used in transmitting the signal information. The given input data is initially parallel and they have to be converted into serial using the shift register for transmission. The receiver section has consists of HT12D decoder which is used to receive the encoded signals. Data are received serially by the decoder. The received signal will be compared with the local trice. If there is no error, then the received data is decoded. ‘VT’ signal level goes high i.e. it goes to logic ‘1’ state to indicate valid transmission. The input data codes are decoded and then transferred to the output pins when there is no error or unmatched pins are found. To indicate a valid transmission the VT pins also go high. Of some series, the HT12D is arranged to provide 8 bits addressing and 4 bits data and HT12F is used to decode 12 bits of address information. 89S52 microcontrollers are used at the receiver section. Whenever the robot moves in a particular direction, the proximity sensor searches for the metal objects i.e. it looks for explosive landmines.

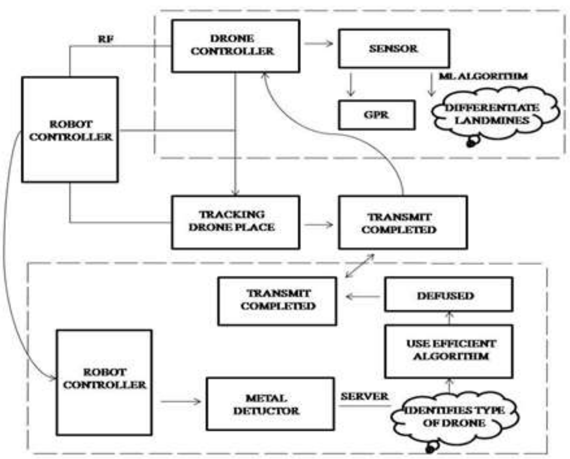

Figure 4. *Overall architecture of the detection and dysfunction model.*

The overall architecture of the detection and dysfunction model is given in the figure 4. The robot controller and the drone controller play a major part in this model. The drone controller and robot controller acts like a transceiver i.e. both can transmit and receive signals. The communication between the drone and controller is established by Radio frequency technology. The drone controller uses sensors for locating the landmine areas based on assumption. Once the landmine areas are detected by the sensors, GPR (Ground Penetrating Radar) helps in detecting the location of landmines. Electromagnetic signal is transmitted to the robot controller which gives the location of the landmine area. Once the command is received by the robot controller, it uses metal detector in locating the exact location of landmines.

After finding the exact location of landmines, the robot controller removes the landmine from the ground surface by using powerful magnets. The robot controller also prevents it from explosion when the mines are attracted by the magnets. In order to prevent explosion during attraction, the robot controller has to ensure whether the mines are attracted under proper pressure. Image processing is used in analysing the overall features of the mine detected. After analysing the mine, the robot controller must use efficient and best possible solution in diffusing the landmine. After the dysfunction of landmine, the robot controller removes the mine from the location detected. Once the entire detection and dysfunction is completed, the control signal is transmitted back to the drone controller as a sign of ‘mission completed successfully’. The above-mentioned process is repeated each time whenever the drone controller detects a landmine location. The Deep learning and machine learning algorithms and tools are used in the detection and dysfunction process. The schematic diagram gives a complete overview of this and let’s see about it. dysfunction of explosive landmines. The schematic diagram (figure 5) gives an overview of the entire

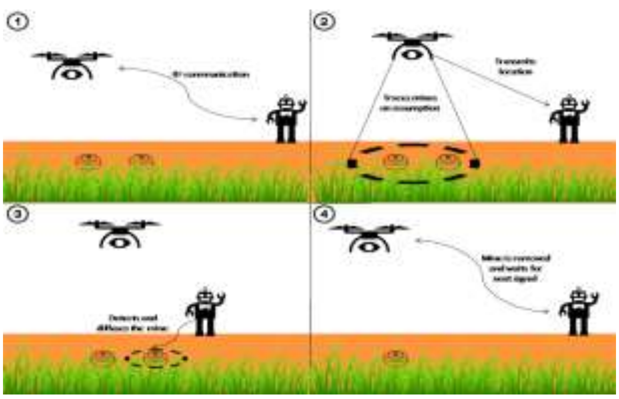

Figure 5. *Overall Schematic diagram.*

As discussed earlier, a flying drone and a detector robot plays a vital role in the detection and process carried out in the detection and dysfunction. The first and second picture illustrates the detection of landmines, third and fourth pictureillustrate the dysfunction of explosive landmines. The main objective behind this technique is detect and dysfunction landmines and prevent it from explosion. The above implementation can be successfully implemented via deep learning algorithms and machine learning tools with accuracy. Initially the drone is made to fly at a height of 400m from the ground level and it searches for the location of landmine areas. Radio frequency communication is established between the drone and the detector robot i.e. both the drone and robot are able to transmit and receive signals. When the flying drone detects a landmine area, electromagnetic signals are transmitted from the drone to the detector robot in the ground. The drone cannot predict the exact location of landmines and just sends the location of estimated area of landmines to the detector robot. Once the detector robot receives the drone's transmitted signal, it moves the estimated location sent by the drone. The detector robot looks for the nearest landmine in the estimated are using k-nearest neighbour algorithm strategy. The detector robot uses Radio detection RD800 and RD400 in locating the exact location of explosive landmines. Once the landmines are detected by the robots, the robots undergo image processing, and then it analyses and collects entire detail about the landmine detected. Based on neural intelligence and image processing, it analyses the size, shape, type of metals used, at what pressure it gets triggered, ground profundity, dampness and other related factors. After collecting entire details of detected mine, the robot used a powerful magnet for removing the mine form the ground surface. The robot must also make sure at what pressure the landmine has to be pulled out from the ground level

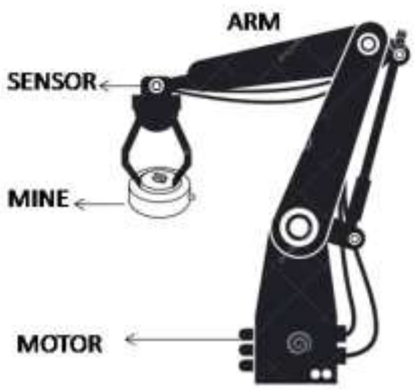

Figure 6. *Landmine Detection Robot.*

and it must also prevent the landmine form explosion during magnetic attraction (shown in figure 6). Once the mine is removed from the ground level then it has to undergo deep learning concept, i.e. it has to think like human cerebrum in diffusing the mine with the best possible solution. Diffusing motors are attached to the robots which guides the robots in dysfunction techniques. The robot uses dimensionality reduction algorithm in estimating and analysing the exact dysfunction solution for the detected mine. Once the landmine is successfully diffused, it removes the landmine from that location and returns it back to the control station. After dysfunction of the landmine, the robot transmits completed signal back to the flying drone as an acknowledgement. The detector robot goes back to its original state after the dysfunction of the landmine. The detector robot also waits for the next command signal from the flying drone to find the next landmine area. Thus, deep learning algorithms combined with machine tools and techniques are used in the detection and dysfunction of landmines. Thus, detector robot is made to think alike human in locating and finding best possible solution in diffusing the robot.

5. Proposed Algorithm

The various Deep learning and Machine learning algorithms are discussed in this section. These algorithms are used in the detection and dysfunction model of landmines in detail. As an overview of this model, there are two controllers namely the drone controller and the robot controller. The drone controller and robot controller undergo communication with the help of Radio Frequency Technology. The drone controller and the robot controller act as transceiver. Transmission and receiving of data signal are established with the help of this Radio Frequency Technology. In general, the flying drone controller acts as the slave and the detector robot acts as the master. The drone works in spotting and detecting the location of landmines areas based on some assumption. Once the location of a landmine is detected by the drone controller, it transmits a signal to the robot controller in detecting and diffusing the explosive mines. The various algorithms are implemented at each layer of execution and final result is drawn.

First and foremost, Gaussian mixture models' technique is used in the location of landmines. Actually, in Gaussian mixture models' subpopulations within an overall population are defined. Similarly in this detection technique, the exact or the accurate location of landmine is not predicted by the drone controller. The drone controller just prediction the location of landmines based on assumption. By making use of this algorithm the drone controller locates a particular geographical area as the area of landmines based on assumption. This particular geographical area may or may not hold mines in their ground. Sometimes the assumption of mines by the drone controller may also go wrong. The drone controller locates the mines only by detecting its metal body. Sometimes its assumption may go wrong; it may detect some metal pieces like nails, steel rods, or other metal pieces etc and so it is clear that it cannot locate the exact location of landmines. Hence this algorithm can be implemented by the drone controller just for assuming and locating the mine areas.

The next layer of implementation is making the robot controller to detect the exact location of the landmines. This can be accomplished by using k-nearest neighbour algorithm. Once the drone controller senses the location of mines by its assumption, it transfers the details of the mine location to robot controller. The control transmitted by the drone controller is received by the robot controller. The communication between the flying drone and the detector robot is established with the help of Radio Frequency communication. The robot controller looks for the nearest landmine from its current position within the given geographic area. For the location of the nearest landmine from its current position it makes use of k-nearest neighbour algorithm. This algorithm helps in locating the most nearest location of mine. Each time whenever the control signal is transferred from the drone controller to the robot controller, the robot controller makes use this k-nearest neighbour algorithm in locating the nearest location of the landmine. Only based on the k-nearest neighbour algorithm all other landmine areas are eliminated other than the most nearest landmine from the mine's position.

Once the area of the nearest landmine is detected, using k-nearest neighbour algorithm, the robot controller moves to that particular location. On reaching the exact mine area, the robot controller senses for the traces of metal using powerful metal detection tool called Radio detection RD800 and RD400. This device simply detects the presence of metal substance on the ground. It just looks for metal substances and does not know to distinguish whether the detected metal is a landmine or some other metal substances. Hence in this layer of detection, Support vector machine techniques is used in detecting whether the metal detected is a landmine or some other metal substance. If the detected metal is matched with the metal of mine, the controller passes to the next layer in the detection and dysfunction mechanism. Or if the metal detected does not comes under mine category, then it is not considered by the metal robot and the robot controller transmits signals back to the drone controller. The drone controller then senses for the next location. The robot controller uses image processing technique in capturing and processing the captured image.

Once the robot locates the exact mine that has to be diffused using the above algorithms, it attracts the mine from the ground level for diffusing it. The mine is attracted by using powerful magnets and the mines are removed from the ground. Once the mines are removed from the ground it captures of the attracted mine. Using image processing technique, it analyses the various features of the detected mine such as shape, size and pressure at which it is triggered. The attraction of mine by using powerful magnets must not trigger the mine to explosion. Hence they must be attracted based on its weight and pressure at which it is triggered. This detection and analysing part in the model is performed by neural layer. This layer makes the robot controller to think like human. This layer makes the robot controller to think and analyse all the features of the mine.

It uses dimensionality reduction technique algorithm for the detection of dysfunction algorithm. Once the mine is detected, its features are analysed by using multiple number of neural network layer. A determining the entire features of the mine, the robot controller uses dimensionality reduction concept in analysing the best diffusing algorithm for the landmine. Based on the features of the mine, the solution for dysfunction is compared with other available algorithms. Dimensionality reduction technique compares each algorithm technique for dysfunction with the features of mine. Based on comparison, it arranges the dysfunction algorithm in a priority sequence, in which the dysfunction algorithm that matches with the features of the mine takes the highest priority. The dysfunction algorithm that does not match with the features of the mine has the lowest priority. Once the robot controller detects the exact algorithm for dysfunction using dimensionality reduction, it diffuses the mine from the ground.

6. Conclusion

Landmine is one of the man - made disaster that have cost the life of more than millions and millions of people. Many people also lost their life due to the traditional method of detection and diffusing these mines. People are not aware of the presence of landmines and accidently they step on these mines. Landmines cannot be completely removed as they are useful in some of the military cases. So, it is in hands of people from staying away from these landmine areas. People living in urban areas have to view the warning sign boards that are placed in the mine areas. Thus, the detection and dysfunction of landmine is implemented using the deep learning and machine learning algorithms and other tools and techniques.

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