INNOCUOUS ANIMAL REPELLANT USING MACHINE LEARNING

A PROJECT REPORT

Submitted by

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ABSTRACT

The deadly conflict between India's growing masses and its wildlife has caused injury, loss of life, damage to human property, crop damage, a threat to livestock, and destruction of human habitats. Electric fences, trenches, manual surveillance, guard dogs, and other methods of habitat protection have been shown to be temporary, non-economic, and dangerous. To initiate safety for both wild animals and humans, some mitigation planning is required. Machine learning can make it moreefficient and push forward the bars that are kept limited with the use of IoT alone. The proposed system aims to protect human habitation and livestock at the outskirts of the forest area by developing an automated system that detects the intrusion of wild animals and repels them back to the forest without causing any harm. In this project, an automatic dual-axis solar tracking system is designed and developed using logistic regression and servo motors for panel movement from east to west directions to spray water on animals to get them away from farm areas. The main objective of this projectis to protect the farm from animals using a repellent system. Thus, the AI-based animal repellent system will make the farm more protective, and the alert system will be made by producing sound against the respective animals.

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LIST OF ABBREVIATION

S.NO.	ABBREVIATION	ACRONYMS
1	**PIR**	Passive Infra red
2	**WSN**	Wireless sensor networks
3	**PC**	Personal computer
4	**SMS**	Short Message Service
5	**ID**	Identification
6	**GSM**	Global System for Mobile communication
7	**GLCM**	Gray level Co-occurrence Matrices
8	**SVM**	Support Vector Machine
9	**GPU**	Graphics Processing Unit
10	**USB**	Universal Serial Bus
11	**IC**	Integrated circuit
12	**AC**	Alternate current
13	**DC**	Direct current
14	**AI**	Artificial Intelligence
15	**ML**	Machine Learning
16	**CNN**	Convolutional Neural Network
17	**KNN**	K-Nearest Neighbour

CHAPTER - 1

INTRODUCTION

1.1 Project Background

India holds around 708,273 square kilometers of forest area, home to nearly 500 species of mammals. Progressing urbanization has led to deforestation, which hasled to the withdrawal of wild animals from their territories. This has resulted in human-wildlife conflicts, which the World Wide Fund for Nature defines as a Human-wildlife conflict. In response to this, locals have adapted preventive techniques such as illegal installations of electric fencing and trenches to protect their fields and livestock from wild animal attacks. On average, one person is killed every day due to this conflict.

Around 1300 wild animals have died due to electrocution in India over the past decade, including over 500 elephants, 220 flamingos, 150 leopards, and 46 tigers. In 2017, the state of Maharashtra recorded over 21 tiger deaths, with six tigers being electrocuted purposely, making this an issue for concern. Most of the wild animal fatality cases are kept unreported or unattended for months, showing the overall negligence of the forest department. To reduce conflicts and fatality rates, many wild animal repellent systems have been invented based on IoT solutions. However, these systems generate a huge amount of unstructured data that will prove difficult to handle by IoT alone. Machine learning can be used to work effectively within the IoT domain, such as in fully automated security where intruders can be detected and reported immediately. AI solutions such as real-time intrusion detection are built on OpenCV and use object detection techniques such as YOLOv3 and GLCM. Once the wild animal is detected, a buzzer sound and flash light will be emitted to repel it back to the forest without causing any threat to its life.

1.2 Introduction to the Animal Repellant System

Crop damage inflicted by animals is one of the biggest challenges throughout the world. Animals such as pigs, monkeys, and many others may cause severe damage to crops. They can damage the plants by feeding on plant parts or onlyby organizing themselves more than the field and squashing the excess crops. Therefore, animals may easily cause significant yield losses and incite additional financial problems. There are numerous methods for reducing the problems or damages caused by animals to the farmer, which destroy the farm. The ways include haunting the animals, producing the sounds manually, and using chemical compounds for repelling birds and animals; some are regulated by state and federal laws while others are untested. The animal repellent system is very effective in driving off the animals from the fields and keeping them away. It accurately determines the presence of animals in the fields and sounds the buzzer. It does not sound the buzzer due to the presence of a human being or due to some random motion. The ultrasonic buzzer is very effective against animals and causes no noisepollution. This system is totally harmless and doesn't injure animals in any way.

A deadly conflict is prominently observed between India's growing masses and its wildlife Injury, loss of life, damage to human property, crop damage, a threat to livestock, and destruction of human habitats are some of its major impacts. adaptation of solutions like electric fences, trenches, manual surveillance, guard dogs, etc. to protect the habitat, been proven to be temporary in their life span, non-economic, and an unsafe solution for wildlife as well as humans. To initiate safety for both wild animals and humans, some mitigation plan is required to solve this issue. While there are many existing IoT-based animal surveillance and repellent systems, a touch of artificial intelligence can make it more efficient and will Push forward the bars that are kept limited by the use of IoT. alone. The proposed system aims at protecting human habitation and livestock at the outskirts of the forest area by developing an automated

system that detects the intrusion of wild animals and repels them back to the forest without causing any harm, thereby minimising the dangerous consequences caused by the conflict.

Agriculture has seen many revolutions, whether the domestication of animals and plants a few thousand years ago, the systematic use of crop rotations and other improvements in farming practice a few hundred years ago, or the “green revolution” with systematic breeding and the widespread use of man-made fertilizers and pesticides a few decades ago. Agriculture is undergoing a fourth revolution triggered by the exponentially increasing use of information and communication technology (ICT) in agriculture. Autonomous, robotic vehicles have been developed for farming purposes, such as mechanical weeding, application of fertilizer, or harvesting of fruits. The development of unmanned aerial vehicles with autonomous flight control, together with the development of lightweight and powerful hyperspectral snapshot cameras that can be used to calculate biomass development and fertilization status of crops, opens the field for sophisticated farm management advice. Moreover, decision-tree models are available now that allow farmers to differentiate between plant diseases based on optical information. Virtual fence technologies allow cattle herd management based on remote-sensing signals and sensors or actuators attached to the livestock.

Autonomous, robotic vehicles have been developed for farming purposes, such as mechanical weeding, application of fertilizer, or harvesting of fruits. The development of unmanned aerial vehicles with autonomous flight control, together with the development of lightweight and powerful hyperspectral snapshot cameras that can be used to calculate biomass development and fertilization status of crops, opens the field for sophisticated farm management advice. Taken together, these technical improvements constitute a technical revolution that will generate disruptive changes in agricultural practices.

1.3 Introduction to a Dual-axis Solar Tracking System

Sustainable power sources are gathered by solar panels in the form of sunlight and converted into power, which would then be able to be utilized to provide capacity to electric loads. The Photovoltaic effect occurs when several points move these free electrons into a directional flow. The aim of this project is to ensure the sunlight rays are falling perpendicularly on the solar panel to give the maximum amount of solar energy. Normally, a solar panel converts only 30 to 40 percent of the incident solar radiation into electrical energy. An automated system is required to get a constant output. Individual solar cells are contained by solar panels, which themselves are made out of layers of silicon, phosphorous, which gives the negative charge, and boron, which gives the positive charge. Solar panels ingest the photons and, in doing so, start an electric flow. The subsequent energy produced from photonsstriking the outside of the solar panel enables electrons to be struck out of their nuclear circles and discharged into the electric field created by solar cells, which at that point should be capable of constantly rotating the solar panel. The solar tracking system was made as a prototype to solve the problem. The unique characteristic of this system is that instead of taking the earth as its reference, it takes the sun as a guiding source. The sunlight is monitored by the active sensors, which rotate the panel in thedirection where the intensity of sunlight is highest. In dual axis solar tracking system the Logistic regression algorithm is applied to rotate the panel according to the mentioned angle. For this model, training and testing will be done based on this logistic regression algorithm. So it will be easy to position the solar tracker with a servo motor at the desired angle. The testing and training data will be given to input them and it computes the data with regression coefficients using Sigmoid function. After finding a relationship between training and testing data, the object position can be determined. By using this tracking system, power would be provided to the water pump for irrigation process. Once the humidity value reaches below the predetermined value, power is supplied to motor driver circuit for driving the water pump for irrigation.

1.4 Statement of Problems

Crop damages inflicted by means of animals are one of the largest challenges in the sector. Animals along with pigs, monkeys, and many others may additionally motivate Spartan harm to crops. They can harm the vegetation by means of feeding on plant components or simplest by means of the organization more than the field and squashing in extra of the vegetation. Therefore, animals may also effortlessly purpose considerable yield losses and incite additional economic issues.

Agriculture farming is the main source of livelihood for many people in different parts of the world. Wild animal attacks are a special challenge for farmers throughout the world. Animals such as deer, wild pigs, rabbits, moles, elephants, monkeys, and many others may cause serious damage to crops. They can harm the vegetation by means of feeding on plant components or simplest by means of the organization more than the field and squashing in extra of the vegetation. They can damage the plants by feeding on plant parts or simply by running over the field and trampling over the crop fields.

Therefore, wild animals may easily cause significant yield losses and provoke additional financial problems. Another aspect to consider is that wild animal crop protection requires a particularly cautious approach. In other words, while utilizing his crop production, every farmer should be aware and take into consideration the fact that animals are living beings and need to be protected from any potential suffering. Elephants or wild boar tramp the vegetation on farmland in need of nutritious food. In this process, resources are spoiled, and sometimes even lives are lost. Human-elephant conflict is more common in South Asia and Africa. Usually, farms are protected with an electrical fence, and animals that try to enter the field behave in an abnormal manner.

1.5 Objectives

To design this security system for farm protection. The main aim is to prevent the loss of crops and to protect the area from animals which pose a major threat to the agricultural areas. It is important to monitor the nearby presence of animals. It diverts the animal by producing sound and spraying water. It is automated depending on the need so there is no manual work, thus saving time and also preventing the loss of crops.

1.6 Applications

1. Protects human habitation and crops from wild animal intrusion and attacks.
2. A unique technique to monitor and repel stray or wild animals entering the fields without causing them any physical harm.
3. Ultrasonic animal repelled produces different sound frequencies depending onthe animal species to repel at a particular time. Hence, the high-frequency and high amount sound waves are used to drive away from the animals, which cause harm to farms.
4. On average, ultrasonic devices emit a sound at about 65,000 Hz which, according to ultrasonic pest control device manufacturers, chases the pests away.

CHAPTER - 2

LITERATURE SURVEY

For Animal Detection based applications, it is of utmost importance that the system monitoring should be efficient and reliable. These applications are used in various scenarios such as Maintaining Livestock, Wild-life Monitoring systems for preventing threatful animals entering the human created areas, behavioral analysis etc. Tedious time-consuming techniques such as image processing in MATLAB for automated detection of animals were used earlier in MATLAB is quite ideal but not available to all. For classification and identification of the animals, the NEC animal dataset is considered and pattern(template) matching technique is used to match the targeted image and template image database. Here the Normalized cross-correlation method is used to match these templates. Further the efficiencies are calculated Confusion matrix parameters.

With advent of IoT solutions, the technology developed over the aid of different hardware's that generated information of the surrounding to help the machine take decisions and perform the expected outcomes. In the authors have given an overview of IoT-based animal monitoring systems. There are many IoT-based animal repellent systems which give false positives on not just animal but also Human Intrusion in the territory. In the author has proposed a system to locate pet animals in small cities. As we know, pet animal monitoring in smart cities is a challenging problem. Few of the classic approaches to identify the animal and surveillance techniques include air tags, GPS, and RFID. It proves to fail providing the full required level of monitoring and tracking of the pets. These devices have many limitations and costly. This paper has the approach to pet animal tracking onthe video stream using deep learning capabilities with the goal to detect and classify the object of interest. While Deep Learning got popular in 2006 due to advances in computing and labelled

training data, many improvements were done in the architecture of neural networks. Before deep learning was widely accepted, computer vision researchers used the traditional machine learning algorithm for automatic detection of animals. These usually involved manual feature extraction and training of the models. This made the necessary requirement of domain knowledge to recognize significant features such as distinctive features of various animal speciesfor Classification task.

Sabeenian et al. 2020 proposed a model that will train the image dataset of monkeys, boar and elephants by establishing a Convolutional Neural Network (CNN), and this model is saved. The saved model will run on the driver code to compare the trained images with the new test images from the live capture. If the one trained animal is discovered during the live capture, an awful sound is produced through speakers to drive the animal away.

Banupriya et al. 2020 proposed developing an algorithm to detect the animals in the wildlife area. This programme classifies animals based on their photos, allowing us to monitor them better. Animal detection and classification can aid in preventing animal-vehicle collisions, the tracking of animals, and the prevention of theft. Effective deep learning algorithms can help attain these goals.

Sharma S. et al. 2017 proposed utilizing computer vision techniques and automatic animal detection on roads for preventing animal-vehicle collisions. The trained system was on approximately 2200 positive and negative images and video clips of animals crossing highways at varying speeds. According to the two-second guideline, our proposed method can inform the driver when the vehicle speed is 35 km/h. Even if the animal is successfully recognized above this speed, the driver does not have enough time to avoid a collision. In terms of detection, our proposed technique achieves an overall accuracy of around 82.5 per cent. A method for

calculating the animal's distance from the camera-mounted vehicle in real world units is also proposed.

Saieshwar Radhakrishnan et al. 2018 used image processing to create an animal incursion detection system. A watershed technique segments the animal images, extracts various items in the image, and checks for any animal threat. The Gabor filter is often used to extract a text-rich region and recognize facial expressions at different frequencies. The supervised learning algorithm Linear SVM is used to train the dataset and classify text and hypertext. Only when the specified zone meets other markers does this algorithm build a barrier, which is the contour.

Nagaraju Andavarapu., et al. (2017), proposed the wild-animal recognition in agriculture farms using W-cohogfor agro security , it has reported that the aim of the paper is recognizing the wild animal in agriculture farms. The images are captured from the cameras installed in the agriculture land. These images are processed to detect whether any animal exists in the image. The liblinear classifier is used for better accuracy for high dimensional data. If animal present in image, the recognition is done using w-cohog, cco occurrence histograms of oriented gradients and the result sent to farmer. The system has better accuracy.

Weiwei Zhang.et al,(2011) proposed the tiger to panda animal head detection". the aim of the paper is animal head detection. The detection result through joint detection based on the shape and texture. These are improved by a new oriented gradient feature, hoog-haar of oriented gradients to effectively capture the texture features and shape of animal head. Brute force detection and deformable detection algorithm used to exploit the shape and texture feature simultaneously. Experiments well-labeled animals image database validate the effectiveness of joint learning approach. Finally, the animal head detector to improve the image search result through

text based online photo search.

Vikram.et al,(2019) proposed the design and implementation of an advanced security system for farm protection from wild animals. The aim of the paper is farm protection from wild animals. Here using security system include image processing techniques to capture the animal using raspberry. The image processing technique the captured image of animal is informed to microprocessor to create the irritation using ultrasonic sound. the gsm technology used for, if the animal crosses specified limit the message will be sent to the farmer. The system will not harmful to animal and develop an security system of agriculture land and avoid the crop losses.

Dr. P. Uma Maheswari and Anjali Rose Rajan [4] proposed the bird intrusion is being detected by the use of wireless sensors and buzzers which produce acoustic sounds. When a bird is being detected by the sensors in the agricultural area the acoustic sounds get activated. This sound irritates the birds. Hence when these sounds are generated the birds will fly away as they cannot accommodate to that sound. Thus the destruction caused by the birds in the agricultural fields can be avoided. These acoustic sounds that are being generated will be produced only when the birds are detected and continuous for a while until the birds are been driven away.

The aim of this project is efficiently converting video of animals at any length into models capable of making accurate behavioural prediction using Long Short-term Memory (LSTM). A foundational step of any animal is the establishment of an accurate behavioural model. Building a model that is capable of defining and predicting an animal's behaviour is critical to advancing ethological theory and research, however many animal models fail to be sufficiently thorough or often do not exist at all. Great pools of data are available for improving these models through recorded video of animals posted on video hosting sites throughout the internet,

however these sources are largely left unused due to their sheer quantity being too much for researchers to manually observe and annotate. This article proposed a pipeline approach for efficiently developing predictive behavioural models using a confluence of machine learning tools. Accuracy in prediction and its significance against a much longer standing time-series analysis statistical model. The results of testing proposed pipeline showed promise in that the LSTM network, trained on the JAABA annotated frames.

Agricultural production is an essential element in the development of human civilization. As the number of Taiwan Macaques increases, the original habitats cannot provide enough space and food for these macaques. So, there are many monkeys break in farm fields to obtain food and make significant agricultural damages. To prevent the croplosses, some protection and warning systems need to be deployed to detect and drive away these monkeys. This article presents a IoT-based system to recognize coming monkeys which can be used to warn the farmers and make some noises to drive out the monkeys. Also, the sensing information and images will be sent back to the server for further intelligent analysis. The system is very useful for farmers in Taiwan because the agricultural damages by monkeys become more and more serious. Also, MQTT-based IoT architecture make the system to be extended easily.

The placement of grazing animals in vineyards requires additional support to the animal husbandry activities. Such support must include the monitoring and the conditioning of animal's location behaviour, especially their feeding posture. With such a system, it is possible to allow sheep to graze in cultivated areas (e.g., vineyards, orchards) without endangering them. This article proposes the overall system architecture, from collars, the mobile nodes carried by sheep, up to the cloud platform with different tasks as data analyses, data processing or data storage. The potential of this platform is proven by an important use case of the Sheep IT project, namely the

detection of moments where sheep present a posture that could put in risk the vines and grapes. A dataset composed of collar's sensor data was built stored taking advantage of the existing platform and each entry was manually classified. Different ML algorithms were then evaluated in order to assess the platform power. All algorithms showed similar accuracy but the results obtained using DT are especially relevant since, their easier interpretation, helped to the definition of posture control algorithm to be implemented on collars.

Due to the expansion of cultivated land into previous wildlife habitat, crop raiding is becoming one of the most conflicts antagonizing human wildlife relationships. This article an integrative approach in the field of Internet of Things for smart Agriculture based on low power devices and open-source systems. The article is to provide a repelling and monitoring system for crop protection against animal attacks and weather conditions. Pattern classification based on deep network outperforms conventional methods in many tasks. However, if the database for training exhibits internal representation that lacks substantial discernibility for different classes, the network is considered that learning is essentially failed. Such failure is evident when the accuracy drops sharply in the experiments performing classification task where the animal sounds are observed similar. To address and remedy the learning problem this article a novel approach was proposed for classifying animal sounds.

CHAPTER - 3

EXISTING SYSTEM

3.1 Block diagram

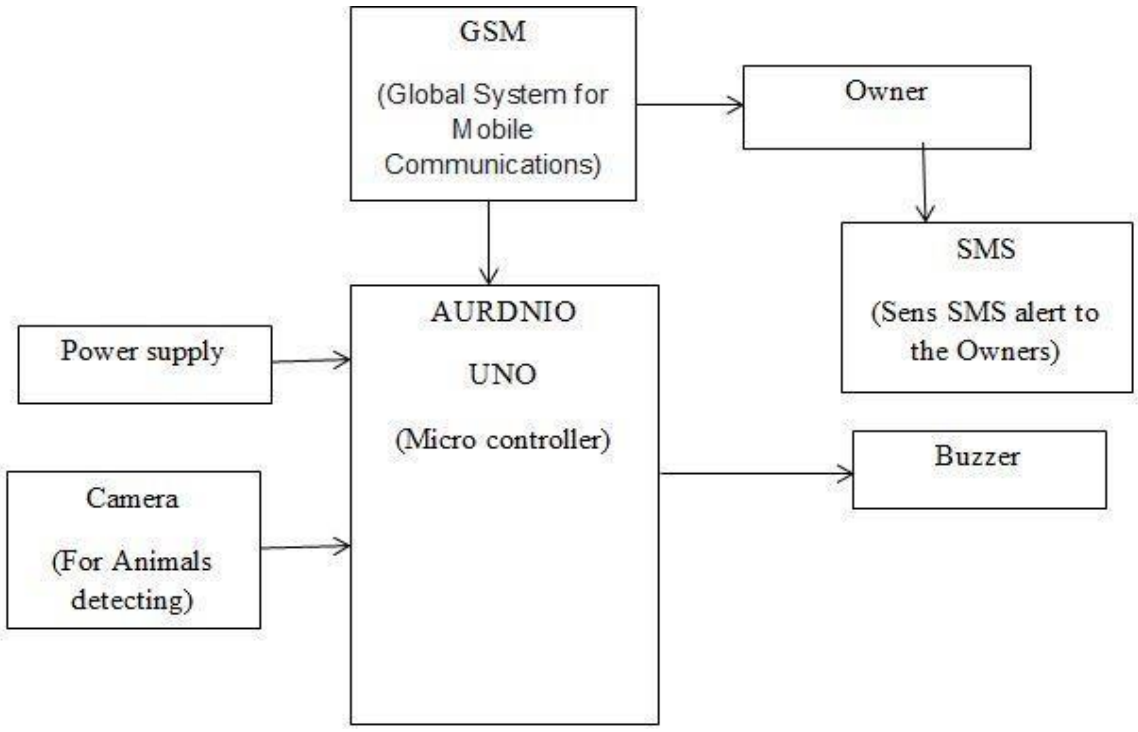

Figure 1

3.2 Working

In the Existing system, PIR Sensors and camera act as first round of security where the animal Movement is detected using the sensor and the sensor in turn triggers the camera to take the picture of the animal and transmit the image for processing via microcontroller i.e., through WSN. The microcontroller transmits the image from the camera to the PC in the command center where the image processing and classification of animal is done. Once the animal is found to be a threat the PC will send the signal to the repellent system via microcontroller to take appropriate action.

Once the animal is classified to be a threat, necessary actions are. SMS notification will be sent to the farmer and the forest official regarding the location of the animal and what type of animal has been trying to intrude the farm. Along with the SMS notification, repellent system of Bright light and irritating loud noise is used simultaneously with interval of 4 seconds is used upon the animal. The repellent system works continuously for better effectiveness in scaring away the animal. The images that are sent by the camera are received by the PC for classification as animals. A database is created, and the set of sample images are stored in it. The programme consists of functions such as indexImage, imageSet, and retrieveImage. The ImageSet is used to hold a collection of images. indexImage is used to create an image search index. indexImage is used with the retrieveImage function to search for images. The captured image is given as a query image to the processing system. The retrieveImage function takes two arguments: a query image and the image stored in the database. Theresultant are the indices corresponding to images within the image index that are visually similar to the query image.

The image IDs output contains the indices in ranked order, from the most to the least similar match. The value match range is 0-1. Ifthe value is 0, then the image is not matched. If it is 1, then the query image is the same as that of the stored image. If the value is found between 0 and 1, then the query image falls under the category of the stored image i.e., the contents of the query image are the same as those of the stored image. If the name of the image matches thatof the regular expression of the image, then the animal is an elephant; otherwise, it is aleopard. If the score is in the range of 0.1 to 0.9, then the image is matched with that ofthe stored image. Once the wild animal is identified, the resulting repellent system is applied. If the animal found is an elephant, then the bright light is emitted. If it isfound to be a leopard, then the irritating loud noise is used. Consequently, an SMS is sent to the forest officials and also to the field owner as alert information. If the detected object is not a threat, then no SMS is sent. By this means, false alarms can be prevented. The animals, many of

are often killed in retaliation or to prevent future conflicts. So this zone is to be monitored continuously to prevent entry of wild animals. With regard to this problem, we have made an effort to develop the system which will monitor the field using sensor and camera and captured image of the intruder will be classified using image processing sothat suitable action can be taken.

3.3 How the proposed system differs from the existing system?

The existing system uses a GSM module and IoT technology to detect the animal and also requires a power supply. In the proposed system, machine learning is used to detect the animals more accurately and repel them. Also, the power from the dual axis solar tracking system is used to spray water on animals to repel them. The entire system is designed to be controlled by a single microprocessor, which is a Raspberry Pi 3 model B. This model will detect the animal species in the camera using the GLCM algorithm. This is one of the most famous and widely used techniques for supervised learning. Compared to all other algorithms, the model has produced the maximum output. Through this algorithm during our model training period. It accurately senses the animal and repels it by providing sound and drizzling water using the power of a dual-axis solar tracking system. Here the panel works by the mechanism of a tracking system that can track Figure 13 sunlight and convert it into electrical energy. This tracker will work without lightdependent sensors since the entire tracking system is designed to be controlled through a logistic regression algorithm in machine learning. A servo motor rotates the solar panel according to the angle of sun irradiation and the time period. The angle of the panel will be changed corresponding to the sun's position, which has been programmed in the algorithm with respect to the time period.

CHAPTER-4

MACHINE LEARNING

Artificial intelligence leverages computers and machines to mimic the human mind's problem-solving and decision-making capabilities. Machine learning is an application of AI. It's the process of using mathematical models of data to help a computer learn without direct instruction. This enables a computer system to continue learning and improving on its own, based on experience. In this Project we are using Machine Learning technique to train and test the Model.

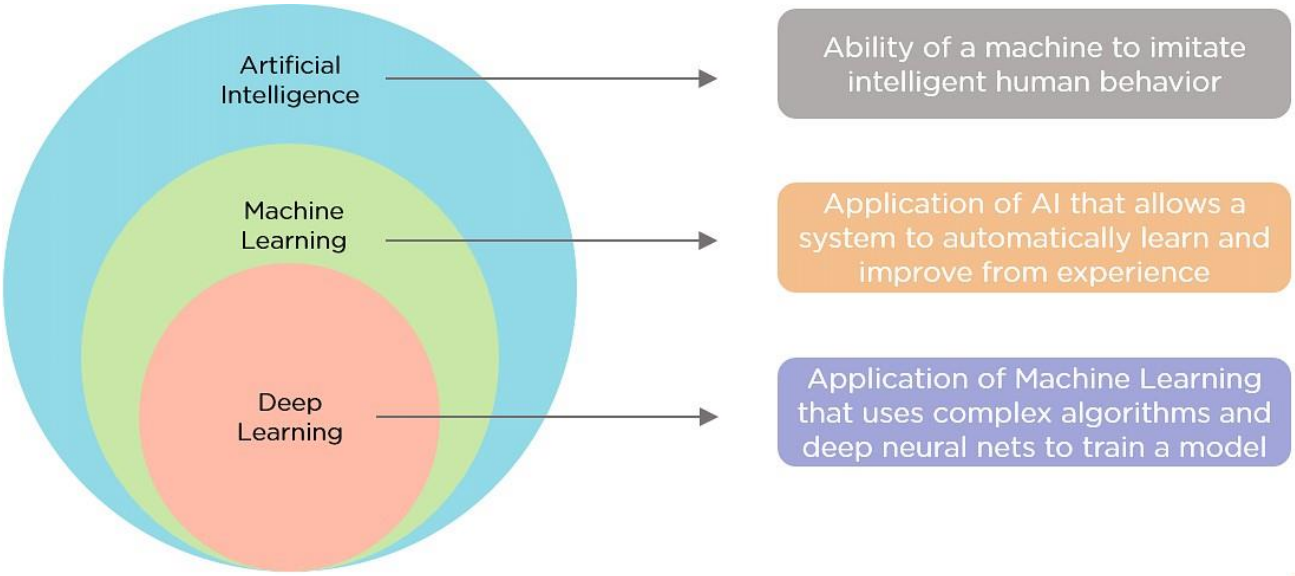

Figure 2

UC Berkely (link resides outside IBM) breaks out the learning system of a machine learning algorithm into three main parts.

2. A Decision Process: In general, machine learning algorithms are used to make a prediction or classification. Based on some input data, which can be labeled or unlabeled, your algorithm will produce an estimate about a pattern in the data.

3. An Error Function: An error function evaluates the prediction of the model. Ifthere are known examples, an error function can make a comparison to assessthe accuracy of the model.
4. A Model Optimization Process: If the model can fit better to the data points in the training set, then weights are adjusted to reduce the discrepancy between theknown example and the model estimate. The algorithm will repeat this "evaluate and optimize" process, updating weights autonomously until a threshold of accuracy has been met.

Training and testing the model:

Training/Testing is a method to measure model accuracy. It is called Training/Testing because we can split the data set into two sets: a training set and a testing set. In this project we use 70% for training, and 30% for testing. Machine learning splits datasets into two subsets. The first subset is known as training data - it's a portion of our actual dataset that is fed into the machine learning model to discover and learn patterns. In this way, it trains our model. The other subset is known as testing data. We can train the model using the training set and test the model using the testing set. Training a machine learning (ML) model is a process in which a machine learning algorithm is fed with training data from which it can learn. Machine learning model testing is the process where a fully trained model is evaluated on a testing set.

Machine Learning algorithms are the programs that can learn the hidden patterns from the data, predict the output, and improve the performance from experiences on their own. Machine learning is an application of AI. It's the process of using mathematical models of data to help a computer learn without direct instruction. This enables a computer system to continue learning and improving on its own, based on experience.

4.1 Types of Machine Learning Algorithms

Machine Learning Algorithm can be broadly classified into three types:

1. Supervised Learning Algorithms
2. Unsupervised Learning Algorithms
3. Reinforcement Learning algorithm

Logistic Regression: Logistic regression is a basic linear model that usesa logistic function for model creation. It categorizes the data into discrete classes by figuring out the relationship trends from the given dataset. It is easy to implement and very efficient to train and can classify unknown data records considerably quickly. But it by default assumes a linear relation between dependent and independent variables which can turn out to be a limitation in the performance of the model in some cases.

Support Vector Machines (SVM): Support Vector Machines or SVM consists of a group of algorithms that analyse data for regression and classification. It represents different classes in a single plane iteratively tominimize the error and is also memory efficient. This makes it one of the best algorithms to use if the error persists in basic linear regression. But in case of noisy datasets and large datasets, its performance dips because of chances of overlapping of classes.

Random Forest Classifier: Random forest algorithm is one of the most famous and a widely used supervised learning technique. It contains a number of decision trees for different subsets of the data instead ofworking on the whole data as a single subset. This improves the accuracy of prediction of the model by several folds as it takes the average of predictions of all the trees and decides the final output on the basis of majority votes of the predictions..

K-Nearest Neighbors(KNN): Also known as lazy learner algorithm is one of the simplest supervised machine learning algorithms. It assumes the similarity among the given dataset and the new data point and put the data point in the category which is most like it. KNN does not make any assumption on the underlying dataset hence it is a non-parametric algorithm.

Decision tree classifier: The algorithm can be applied to both classification and regression problems using non-parametric supervised machine learning. It is called a decision tree because it starts with a root node which in future expands its branches and forms a tree-like structure. Each node represents a feature of the dataset, a decision rule, and an output of those decisions. The decision tree compares the data point to theroot node. Based on the comparison follow the respective branch and jumps to next node till it reaches to the leaf node. ML algorithms such as decision trees mimic human decision making ability.

Naive Bayes Classifier: Based on Bayes Theorem, Naive Bayes Classifier assumes that each feature contributes independently and equally to the outcome. It predicts the output based on probability so it'sa probabilistic classifier. The naïve bayes greatly perform in large and categorical dataset. Its assumption of independent predictors is a limitation because it is nearly impossible in the real world that we get aset of predictors that are completely independent.

4.2 Real-world machine learning use cases

Here are just a few examples of machine learning you might encounter every day:

Speech recognition: It is also known as automatic speech recognition (ASR), computer speech recognition, or speech-to-text, and it is a capability which uses natural language processing (NLP) to translate human speech into a written format. Many mobile devices

incorporate speech recognition into their systems to conduct voice search—e.g. Siri—or improve accessibility for texting.

Customer service: Customer service: Online chatbots are replacing human agents along the customer journey, changing the way we think about customer engagement across websites and social media platforms. Chatbots answer frequently asked questions (FAQs) about topics such as shipping, or provide personalized advice, cross-selling products or suggesting sizes for users. Examples include virtual agents on e-commerce sites; messaging bots, using Slack and Facebook Messenger; and tasks usually done by virtual assistants and voice assistants.

Computer vision: This AI technology enables computers to derive meaningful information from digital images, videos, and other visual inputs, and then take the appropriate action. Powered by convolutional neural networks, computer vision has applications in photo tagging on social media, radiology imaging in healthcare, and self-driving cars in the automotive industry.

Recommendation engines: Using past consumption behavior data, AI algorithms can help to discover data trends that can be used to develop more effective cross-selling strategies. This approach is used by online retailers to make relevant product recommendations to customers during the checkout process.

Automated stock trading: Designed to optimize stock portfolios, AI-driven high-frequency trading platforms make thousands or even millions of trades per day without human intervention.

Fraud detection: Banks and other financial institutions can use machine learning to spot suspicious transactions. Supervised learning can train a model using information about known fraudulent transactions. Anomaly detection can identify transactions that look atypical and deserve further investigation.

4.3 GLCM Machine Learning Algorithm

A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixels with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix.

Gray Level Co-occurrence Matrix (GLCM) is used for texture analysis. We consider two pixels at a time, called the reference and the neighbour pixel. We define a particular spatial relationship between the reference and neighbour pixel before calculating the GLCM. For e.g., we may define the neighbour to be 1 pixel to the right of the current pixel, or it can be 3 pixels above, or 2 pixels diagonally (one of NE, NW, SE, SW) from the reference.

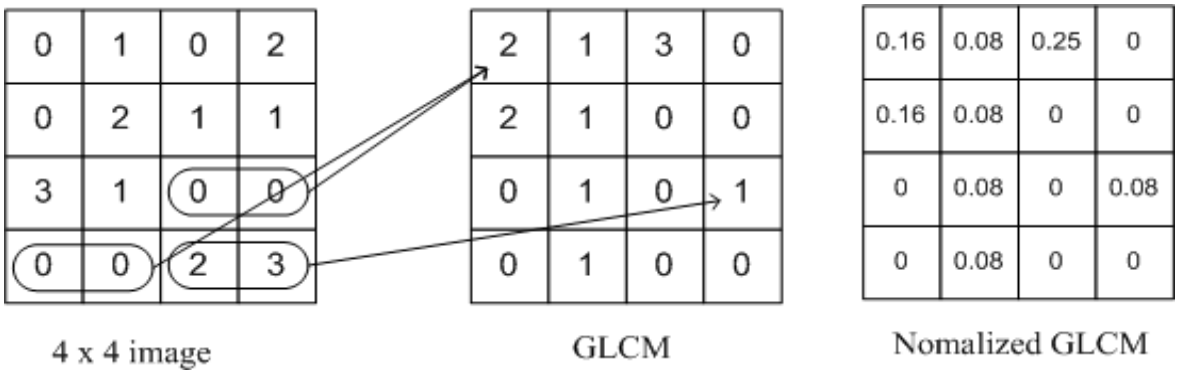

Figure 3

Once a spatial relationship is defined, we create a GLCM of size (Range of Intensities x Range of Intensities) all initialised to 0. For e.g., an 8-bit single channel Image will have a 256x256 GLCM. We then traverse through the image and for every pair of intensities we find for the defined spatial relationship, we increment that cellof the matrix. Each entry of the GLCM[i,j] holds the count of the number of times that pair of intensities appears in the image with the defined spatial

relationship. Thematrix may be made symmetrical by adding it to its transpose and normalised to thateach cell expresses the probability of that pair of intensities occurring in the image.Once the GLCM is calculated, we can find texture properties from the matrix torepresent the textures in the image.

The following features and parameters were detected by GLCM:

- Energy
- Contrast
- Entropy
- Correlation
- Homogeneity

The quantity of dim levels in the picture determines the size of the GLCM. Graycomatrix uses scaling to reduce the number of intensity values in an image to eight by default. However, you can control this scaling of grey levels by utilising the NumLevels and GrayLimits parameters. The spatial distribution of the grey levels in the texture image can be learned from the gray-level co-occurrence matrix. The GLCM can also be used to calculate a number of statistical measures. The GLCM algorithm is used for parameter detection. These statistics provide information about the texture ofan image. They provide statistics likecontrast,correlation, energy, and homogeneity.GLCM uses the texture classification concept. The The texture classification concept is classified using the homogeneity value. The homogeneity value is calculated for every pixel to appear inside the image.

4.4 SUPPORT VECTOR MACHINE ALGORITHM

Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data pointin the correct category in the future. This best decision boundary is called a hyperplane.

SVM chooses the extreme points/vectors that help in creating the hyperplane. These extreme cases are called as support vectors, and hence algorithm is termed as Support Vector Machine. Consider the below diagram in which there are two different categories that are classified using a decision boundary or hyperplane:

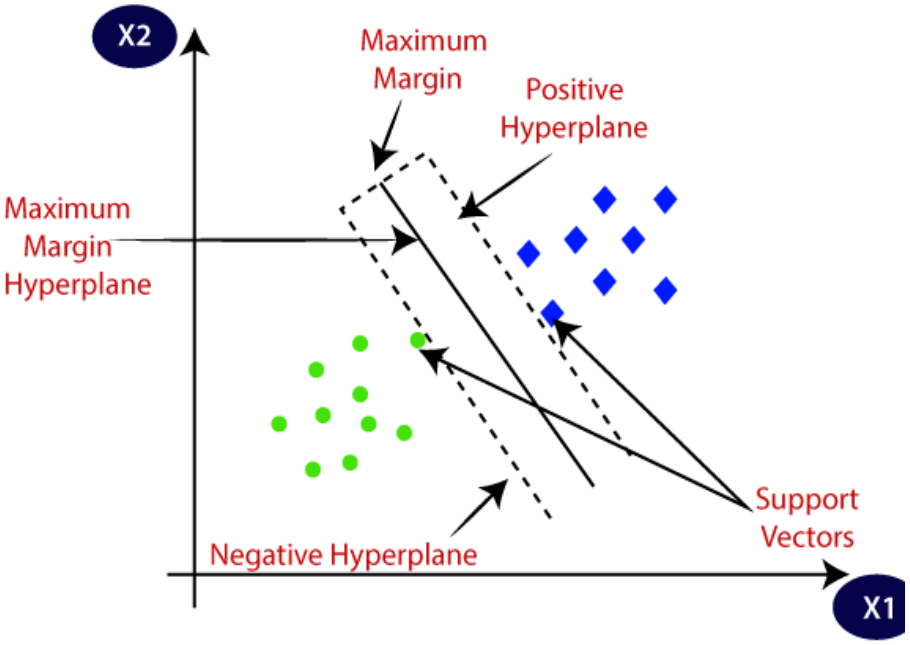

Figure 4

Example: SVM can be understood with the example that we have used in the KNN classifier. Suppose we see a strange cat that also has some features of dogs, so if we want a model that can accurately identify whether it is a cat or dog, so such a model can be created by using the SVM algorithm. We will first train our model with lots of images of cats and dogs so that it can learn about different features of cats and dogs, and then we test it with this strange creature. So as support vector creates a decision boundary between these two data (cat and dog) and choose extreme cases (support vectors), it will see the extreme case of cat and dog. On the basis of the support vectors, it will classify it as a cat. Consider the below diagram:

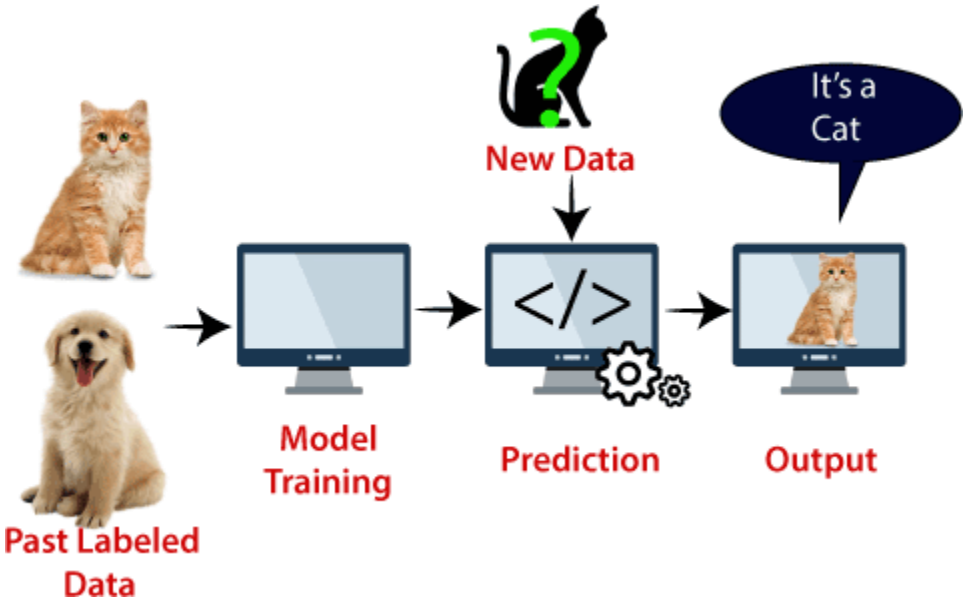

Figure 5

SVM algorithm can be used for **Face detection, image classification, text categorization,** etc. Support Vector Machines or SVM consists of a group of algorithms that analyse data for regression and classification. It represents different classes in a single plane iteratively tominimize the error and is also memory efficient. This makes it one of the best algorithms to use if the error persists in basic linear regression. But in case of noisy datasets and large datasets, its performance dips because of chances of overlapping of classes.

A simple linear SVM classifier works by making a straight line between two classes. That means all of the data points on one side of the line will represent a category and the data points on the other side of the line will be put into a different category. This means there can be an infinite number of lines to choose from. What makes the linear SVM algorithm better than some of the other algorithms, like k-nearest neighbors, is that it chooses the best line to classify your data points. It chooses the line that separates the data and is the furthest away from the closet data points as possible. A 2-D example helps to make sense of all the machine learning jargon. Basically you have some data points on a grid. You're trying to separate these data points by the category they should fit in, but you don't want to have any data in the wrong category. That means you're trying to find the line between the two closest points that keeps the other data points separated. So the two closest data points This means there can be an give you the support vectors you'll use to find that line. That line is called the decision boundary.

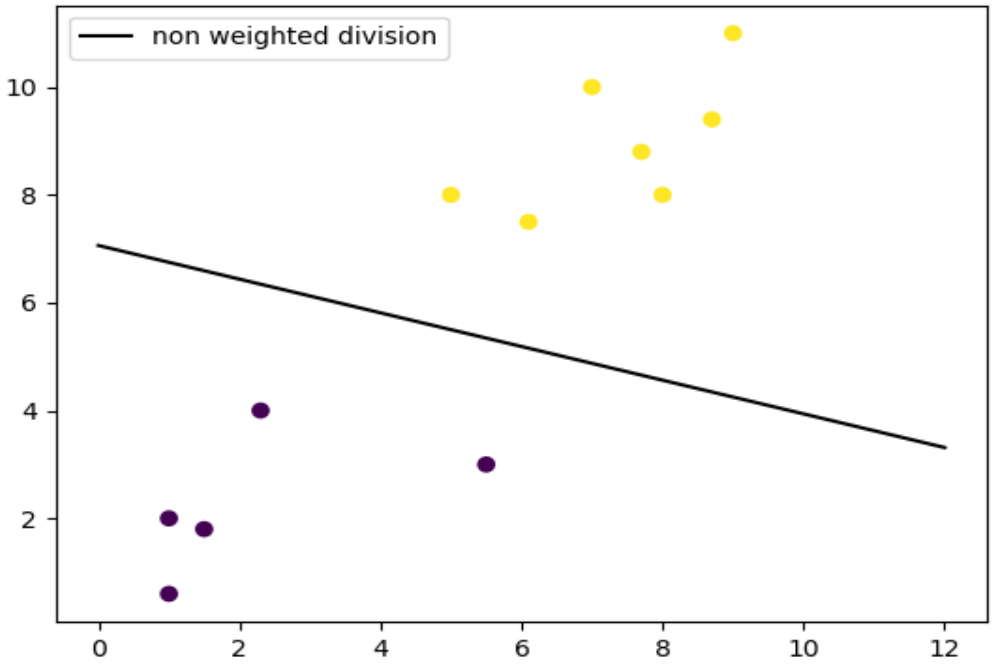

Figure 6

The decision boundary doesn't have to be a line. It's also referred to as a hyperplane because you can find the decision boundary with any number of features, not just two.

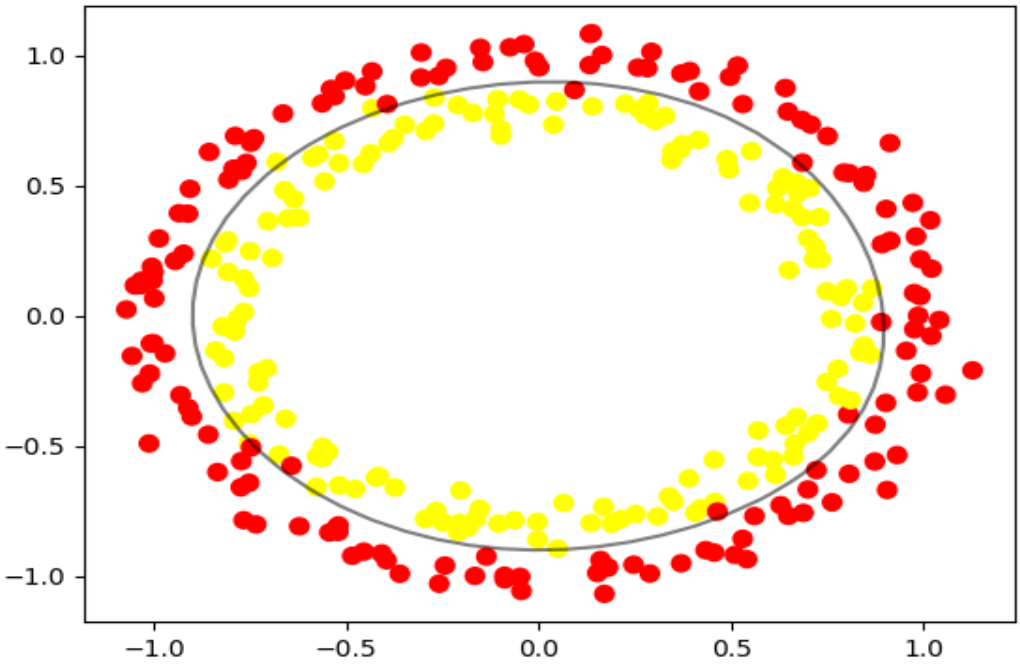

Figure 7

Types of SVMs

There are two different types of SVMs, each used for different things:

- Simple SVM: Typically used for linear regression and classification problems.
- Kernel SVM: Has more flexibility for non-linear data because you can add more features to fit a hyperplane instead of a two-dimensional space.

Why SVMs are used in machine learning

SVMs are used in applications like handwriting recognition, intrusion detection, face detection, email classification, gene classification, and in web pages. This is one of the reasons we use SVMs in machine learning. It can handle both classification and regression on linear and non-linear data.

Another reason we use SVMs is because they can find complex relationships between your data without you needing to do a lot of transformations on your own. It's a great option when you are working with smaller datasets that have tens to hundreds of thousands of features. They typically find more accurate results when compared to other algorithms because of their ability to handle small, complex datasets.

Here are some of the pros and cons for using SVMs

Pros

- Effective on datasets with multiple features, like financial or medical data.
- Effective in cases where number of features is greater than the number of data points.
- Uses a subset of training points in the decision function called support vectors which makes it memory efficient.
- Different kernel functions can be specified for the decision function. You can use common kernels, but it's also possible to specify custom kernels.

Cons

- If the number of features is a lot bigger than the number of data points, avoiding over-fitting when choosing kernel functions and regularization term is crucial.
- SVMs don't directly provide probability estimates. Those are calculated using an expensive five-fold cross-validation.
- Works best on small sample sets because of its high training time.

Since SVMs can use any number of kernels, it's important that you know about a few of them.

Kernel Functions

.The linear kernel works really well when there are a lot of features, and text classification problems have a lot of features. **Linear kernel** functions are faster than most of the others and you have fewer parameters to optimize.

Here's the function that defines the linear kernel:

f(X) = w^T * X + b

In this equation, **w** is the weight vector that you want to minimize, **X** is the data that you're trying to classify, and **b** is the linear coefficient estimated from the training data. This equation defines the decision boundary that the SVM returns.

The **polynomial kernel** isn't used in practice very often because it isn't as computationally efficient as other kernels and its predictions aren't as accurate.

Here's the function for a polynomial kernel:

f(X1, X2) = (a + X1^T * X2) ^ b

This is one of the more simple polynomial kernel equations you can use. **f(X1, X2)** represents the polynomial decision boundary that will separate your data. **X1** and **X2** represent your data.

Gaussian Radial Basis Function (RBF)

One of the most powerful and commonly used kernels in SVMs. Usually the choice for non-linear data.

Here's the equation for an RBF kernel:

f(X1, X2) = exp(-gamma * ||X1 - X2||^2)

In this equation, **gamma** specifies how much a single training point has on the other data points around it. **||X1 - X2||** is the dot product between your features.

Sigmoid

More useful in neural networks than in support vector machines, but there are occasional specific use cases.

Here's the function for a sigmoid kernel:

f(X, y) = tanh(alpha * X^T * y + C)

In this function, **alpha** is a weight vector and **C** is an offset value to account for some mis-classification of data that can happen.

Examples with datasets

To show you how SVMs work in practice, we'll go through the process of training a model with it using the Python Scikit-learn library.

Here are the steps regularly found in machine learning projects:

- Import the dataset
- Explore the data to figure out what they look like
- Pre-process the data
- Split the data into attributes and labels
- Divide the data into training and testing sets
- Train the SVM algorithm
- Make some predictions
- Evaluate the results of the algorithm

4.5 LOGISTIC REGRESSION MACHINE LEARNING

Logistic regression is one of the most popular Machine Learning algorithms, which comes under the Supervised Learning technique. It is used for predicting the categorical dependent variable using a given set of independent variables.

Logistic regression predicts the output of a categorical dependent variable. Therefore, the outcome must be a categorical or discrete value. It can be either Yes or No, 0 or 1, true or False, etc. but instead of giving the exact value as 0 and 1, **it gives the probabilistic values which lie between 0 and 1**. Logistic Regression is much similar to the Linear Regression except that how they are used. Linear Regression is used for solving Regression problems, whereas **Logistic regression is used for solving the classification problems**. In Logistic regression, instead of fitting a regression line, we fit an "S" shaped logistic function, which predicts two maximum values (0 or 1). The curve from the logistic function indicates the likelihood of something such as whether the cells are cancerous or not, a mouse is obese or not based on its weight, etc.

Logistic regression is used to solve classification problems, and the most common use case is binary logistic regression, where the outcome is binary (yes or no). In the real world, you can see logistic regression applied across multiple areas andfields. Logistic regression is a basic linear model that usesa logistic function for model creation. It categorizes the data into discrete classes by figuring out the relationship trends from the given dataset. It is easy to implement and very efficient to train and can classify unknown data records considerably quickly. But it by default assumes a linear relation between dependent and independent variables which can turn out to be a limitation in the performance of the model in some cases. Logistic Regression is a significant machine learning algorithm because it has the ability to provide probabilities and classify new data using continuous and discrete datasets.

- In health care, logistic regression can be used to predict if a tumor is likely to bebenign or malignant.
- In the financial industry, logistic regression can be used to predict if a transaction is fraudulent or not.
- In marketing, logistic regression can be used to predict if a targeted audiencewill respond or not.

Logistic Regression is a significant machine learning algorithm because it has the ability to provide probabilities and classify new data using continuous and discrete datasets. Logistic Regression can be used to classify the observations using different types of data and can easily determine the most effective variables used for the classification. The below image is showing the logistic function:

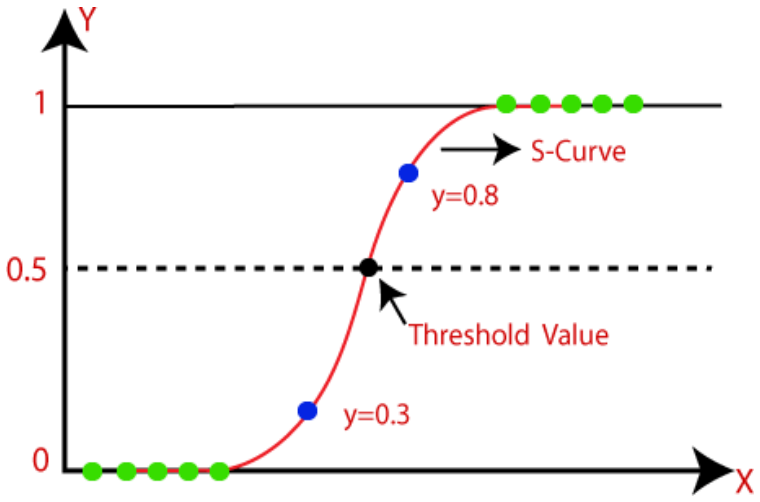

Figure 8

In dual axis solar tracking system the Logistic regression algorithm is applied to rotate the panel according to the mentioned angle. For this model, training and testing will be done based on this logistic regression algorithm. So it will be easy to position the solar tracker with a servo motor at the desired angle. The testing and training data will be given to input them and it computes the data with regression coefficients using Sigmoid function. After finding a relationshipbetween training

and testing data, the object position can be determined. By using this tracking system, power would be provided to the water pump for irrigation process. Once the humidity value reaches below the predetermined value, power is supplied to motor driver circuit for driving the water pump for irrigation.

Assumptions for Logistic Regression:

- The dependent variable must be categorical in nature.
- The independent variable should not have multi-collinearity.

Logistic Regression Equation:

The Logistic regression equation can be obtained from the Linear Regression equation. The mathematical steps to get Logistic Regression equations are given below:

- We know the equation of the straight line can be written as:

$$y= b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \cdots + b_nx_n$$

- In Logistic Regression y can be between 0 and 1 only, so for this let's divide the above equation by (1-y):

$$\frac{y}{1-y}$$; 0 for y= 0, and infinity for y=1

- But we need range between -[infinity] to +[infinity], then take logarithm of the equation it will become:

$$log\left[\frac{y}{1-y}\right] = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \cdots + b_nx_n$$

The above equation is the final equation for Logistic Regression.

Types of logistic regression

On the basis of the categories, Logistic Regression can be classified into three types:

- **Binomial:** In binomial Logistic regression, there can be only two possible types of the dependent variables, such as 0 or 1, Pass or Fail, etc.
- **Multinomial:** In multinomial Logistic regression, there can be 3 or more possible unordered types of the dependent variable, such as "cat", "dogs", or "sheep"
- **Ordinal:** In ordinal Logistic regression, there can be 3 or more possible ordered types of dependent variables, such as "low", "Medium", or "High".

Training data assumptions for logistic regression

Training data that satisfies the below assumptions is usually a good fit for logistic regression.

- The predicted outcome is strictly binary or dichotomous. (This applies to binary logistic regression).
- The factors, or the independent variables, that influence the outcome are independent of each other. In other words there is little or no multicollinearity among the independent variables.
- The independent variables can be linearly related to the log odds.
- Fairly large sample sizes.

If your training data does not satisfy the above assumptions, logistic regression may not work for your use case. logistic regression is used for classification problems when the output or dependent variable is dichotomous or categorical. There are some assumptions to keep in mind while implementing logistic regressions, such as the different types of logistic regression and the different types of independent variables and the training data available.

CHAPTER – 5

PROPOSED SYSTEM

5.1 Block Diagram

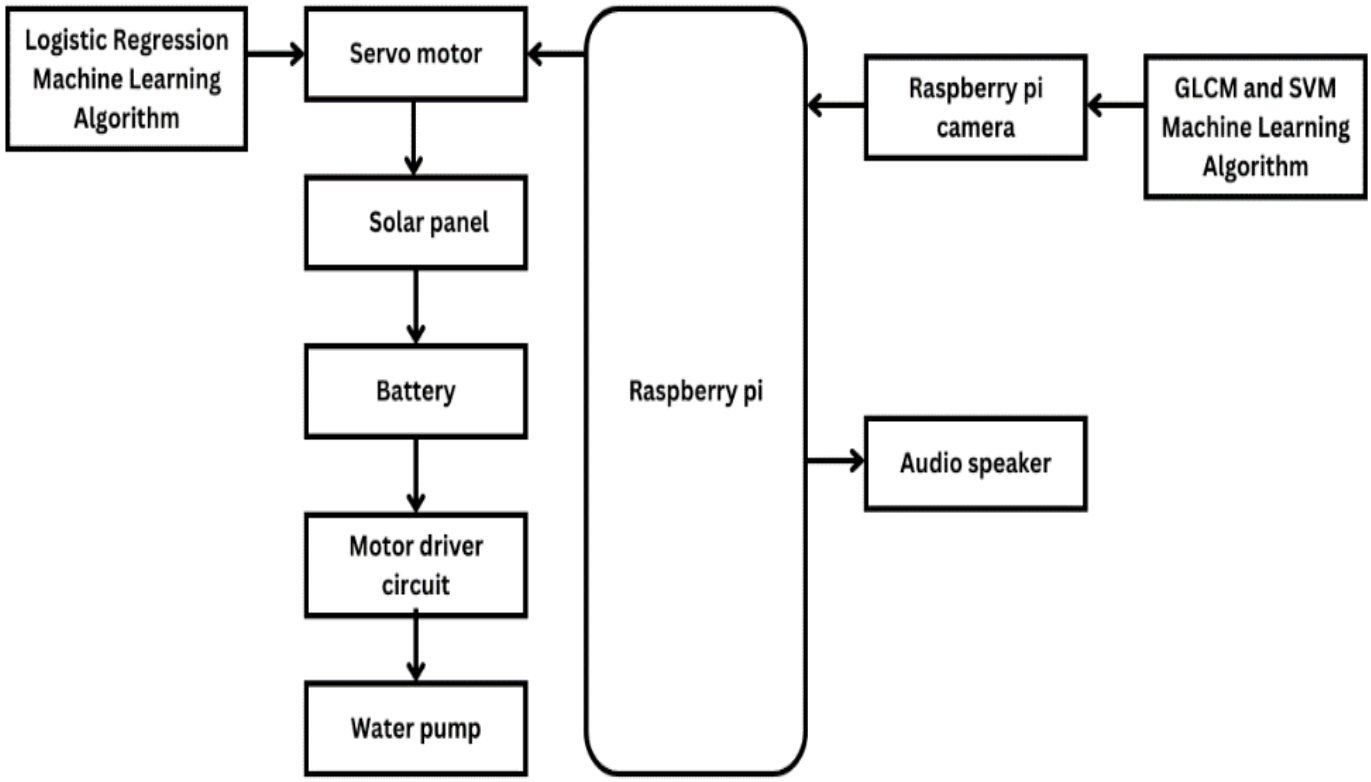

Figure 9

5.2 Working Principle

In this project, we tend to provide protection from the attacks of wild animals and thus minimizing the probable loss to the farmer. The project is used to detect intrusion around the field by animals. Then captures the image of the respective animal and sends an alarming sound. A timid sound is produced based on the animals which will drive the animals off the field as soon as possible. In addition to that, water is

sprayed on the animal, to drive them quickly. The Raspberry pi 3 model B is used. It is a more powerful processor, 10x faster than the first generation Raspberry Pi. Additionally, it adds wireless LAN & Bluetooth connectivity making it the idealsolution for powerful connected designs. The main advantage of the raspberry pi camera over a USB webcam is that it is able to make use of the graphics processing capability of the Broadcom CPU. An audio device can be connected to the system to provide timid sound to repel animals away.

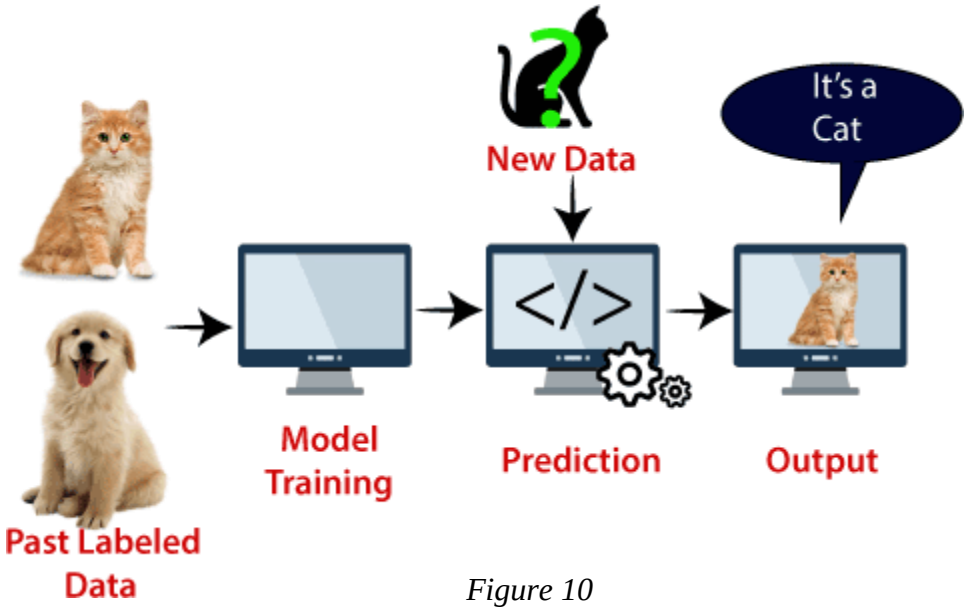

Figure 10

The proposed method was composed of feature extraction and classification. In the proposed system we are using three machine learning algorithms. The GLCM algorithm is used for parameter detection. These statistics provide information about the texture of an image. They provide statistics like contrast, correlation, energy, homogeneity. The SVM algorithm is used for both classification and regression. In the image dataset, there will be a collection of digital images for every animals. Once the image is set, pre-processing begins. Preprocessing is the process of preparing the raw data and making it suitable to the model. After pre processing, this raw data is converted into numerical features in feature extraction. Once the model is extracted , it is trained using SVM algorithm. After completion the model is saved for testing. In the SVM

algorithm, there is already a trained model. Based on the trained image dataset , if we provide input. It recognises the trained dataset and produces output. If the camera detects the animal that is already trained, it produces a timid sound to repel it away.

In dual axis solar tracking system the Logistic regression algorithm is applied to rotate the panel according to the mentioned angle. For this model, training and testing will be done based on this logistic regression algorithm. So it will be easy to position the solar tracker with a servo motor at the desired angle. The testing and training data will be given to input them and it computes the data with regression coefficients using Sigmoid function. After finding a relationship between training and testing data, the object position can be determined. By using this tracking system, power would be provided to the water pump for irrigation process. Once the humidity value reaches below the predetermined value, power is supplied to motor driver circuit for driving the water pump for irrigation.

Crop damage inflicted by animals is one of the biggest challenges throughout the world. Animals such as pigs, monkeys, and many others may cause severe damage to crops. They can damage the plants by feeding on plant parts or only by organizing themselves more than the field and squashing the excess crops. There are numerous methods for reducing the problems or damages caused by animals to the farmer, which destroy the farm. The ways include haunting the animals, producing the sounds manually, and using chemical compounds for repelling birds and animals; some are regulated by state and federal laws while others are untested. The animal repellent system is very effective in driving off the animals from the fields and keeping them away. It accurately determines the presence of animals in the fields and sounds the buzzer. It does not sound the buzzer due to the presence of a human being or due to some random motion. The ultrasonic buzzer is very effective against animals and causes no noisepollution. This system is totally harmless and doesn’t injure animals in any way.

Train the model:

In the image dataset, there will be a collection of digital images for every animals. Once the image is set, pre-processing begins. Preprocessing is the process of preparing the raw data and making it suitable to the model. After pre processing, this raw data is converted into numerical features in feature extraction. Once the model is extracted , it is trained using SVM algorithm. After completion the model is saved for testing. In the SVM algorithm, there is already a trained model. Based on the trained image dataset , if we provide input. It recognises the trained dataset and produces output. If the camera detects the animal that is already trained, it produces a timid sound to repel it away. Once the model produces maximum accuracy, the algorithm tests themodel by saving it.

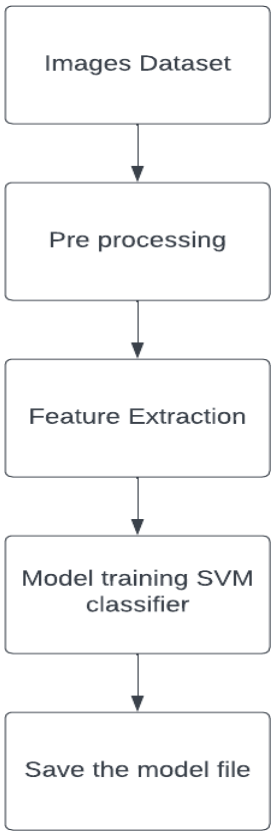

Figure 11

Testing the model:

The GLCM algorithm is used for parameter detection. They provide statistics like contrast, correlation, energy, homogeneity. The SVM algorithm is used for both classification and regression. In the image dataset, there will be a collection of digital images for every animals. Once the image is set, pre-processing begins. Preprocessing is the process of preparing the raw data and making it suitable to the model. After pre processing, this raw data is converted into numerical features in feature extraction. Once the model is extracted , it is trained using SVM algorithm. After completion the model is saved for testing. In the SVM algorithm, there is already a trained model. Based on the trained image dataset , if we provide input. It recognises the trained dataset and produces output. If the camera detects the animal that is already trained, it produces a timid sound to repel it away.

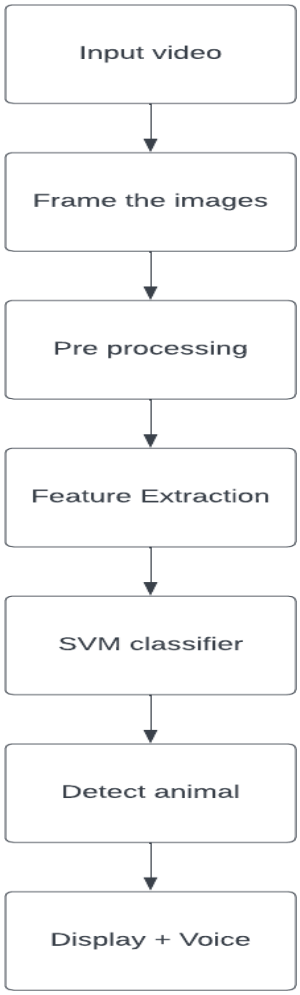

Figure 12

ML Algorithm Used in Solar tracker:

In dual axis solar tracking system the Logistic regression algorithm is applied to rotate the panel according to the mentioned angle. For this model, training and testing will be done based on this logistic regression algorithm. So it will be easy to position the solar tracker with a servo motor at the desired angle. The testing and training data will be given to input them and it computes the data with regression coefficients using Sigmoid function. After finding a relationship between training andtesting data, the object position can be determined. By using this tracking system, power would be provided to the water pump for irrigation process. Once the humidityvalue reaches below the predetermined value, power is supplied to motor driver circuit for driving the water pump for irrigation.

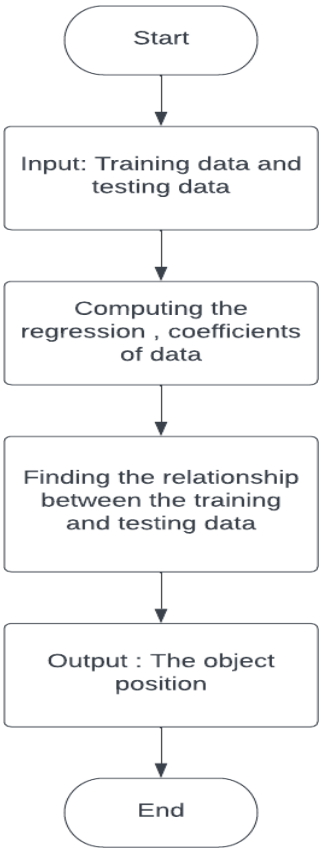

Figure 13

Advanced Ip Scanner And Putty Software:

Advanced IP Scanner is a fast and powerful network scanner with a user friendly interface. In seconds, Advanced IP Scanner can locate all computers on your wired or wireless local network and scan their ports. The program provides easy access to various network resources such as HTTP, HTTPS, FTP, and shared folders.

PUTTY:

Putty is a free and open-source terminal emulator, serial console and network file transfer application. It supports several network protocols, including SCP, SSH, Telnet, rlogin, and raw socket connection. It can also connect to a serial port.

Python 3.7:

Python is a computer programming language often used to build websites and software, automate tasks, and conduct data analysis. Python is a general-purpose language, meaning it can be used to create a variety of different programs and isn't specialized for any specific problems. This versatility, along with its beginner-friendliness, has made it one of the most-used programming languages today. We have coded the project using Python 3.7, which adds updated classes for data handling, optimizes script compilation for garbage collection, and improves asynchronous I/O. Python 3.7, the latest language version aimed at making complex tasks simple, is now in production release.

5.3 Significance of the Proposed System

India is an agricultural country. Agriculture has always been India's mostimportant economic sector. Though most of India's population depends on agriculture, there are still many problems faced by farmers. Human-animal conflict is a major problem where enormous amounts of resources are lost and human lives arein danger. In recent times, the number of these kinds of conflicts has been increasing. So this zone is to be monitored continuously to prevent the entry of this kind of animal or any other unwanted intrusion. Human-animal conflicts arise due to encroachment and poaching; humans move into the forest to satisfy their livelihoods; the claiming of land for agricultural practises and rapid industrialization cause the spread of urban ground; and animals enter the nearby villages for water during the summer due to the dryness of the water bodies. Elephants or wild boar tramp the vegetation on farmland in need of nutritious food. In this process, resources are wasted, and sometimes even lives are lost. Human-elephant conflict is more common in South Asia and Africa. Usually, farms are protected with an electrical fence, and animals that try to enter the field behave in an abnormal manner. Further using AI techniques like object detection, the system will detect only Wild Animals and avoid false positives occurred in the presence of Humans.

Agriculture has seen many revolutions, whether the domestication of animals and plants a few thousand years ago, the systematic use of crop rotations and other improvements in farming practice a few hundred years ago, or the “green revolution” with systematic breeding and the widespread use of man-made fertilizers and pesticides a few decades ago. Agriculture is undergoing a fourth revolution triggered by the exponentially increasing use of information and communication technology (ICT) in agriculture. Autonomous, robotic vehicles have been developed for farming purposes, such as mechanical weeding, application of fertilizer, or harvesting of fruits.

The development of unmanned aerial vehicles with autonomous flight control, together with the development of lightweight and powerful hyperspectral snapshot cameras that can be used to calculate biomass development and fertilization status of crops, opens the field for sophisticated farm management advice. Moreover, decision-tree models are available now that allow farmers to differentiate between plant diseases based on optical information. Virtual fence technologies allow cattle herd management based on remote-sensing signals and sensors or actuators attached to the livestock. Taken together, these technical improvements constitute a technical revolution that will generate disruptive changes in agricultural practices. This trend holds for farming not only in developed countries but also in developing countries, where deployments in ICT (e.g., use of mobile phones, access to the Internet) are being adopted at a rapid pace and could become the game-changers in the future (e.g., in the form of seasonal drought forecasts, climate-smart agriculture).

The entire system is designed to be controlled by a single microprocessor, which is a Raspberry Pi 3 model B. This model will detect the animal species in the camera using the GLCM algorithm. So this zone is to be monitored continuously to prevent the entry of this kind of animal or any other unwanted intrusion. Human-animal conflicts arise due to encroachment and poaching; humans move into the forest to satisfy their livelihoods; the claiming of land for agricultural practises and rapid industrialization cause the spread of urban ground; and animals enter the nearby villages for water during the summer due to the dryness of the water bodies. Elephants or wild boar tramp the vegetation on farmland in need of nutritious food. This is one of the most famous and widely used techniques for supervised learning. Compared to all other algorithms, the model has produced the maximum output. Through this algorithm during our model training period. It accurately senses the animal and repels it by providing sound and drizzling water using the power of a dual-axis solar tracking system. Here the panel works by the mechanism of a tracking system that can track sunlight and convert it into electrical energy.

The objective of our project is to provide protection from the attacks of the wild animals, thus minimising the probable loss to the farmer. To detect intrusions around the field. To capture the image of the intruder and classify them using image processing. Taking suitable action based on the type of intruder and repelling them by providing sounds.

5.4 Hardware Tools

- Raspberry pi 3 model b
- Solar panel 12v
- Servo motor 360 MG996R
- Motor driver l29 3d
- Raspberry pi camera
- Water pump
- Battery
- Audio Devices

5.5 Software Tools

- Python
- Advanced IP scanner
- Putty
- SVM Algorithm Machine learning
- SVM Algorithm Machine learning
- Logistic regression Machine learning

5.6 OVERVIEW OF COMPONENTS

5.6.1 Solar Panel 12V

A solar panel is one component of a photovoltaic system. They are constructed out of a series of photovoltaic cells arranged into a panel. They come in a variety of rectangular shapes and are installed in combination to generate electricity. A 12-volt solar panel is very compact and easy to carry around. It is a convenient stand-alone PV panel that traps sunlight to convert solar energy into electrical energy.

Figure 14

Solar energy is a great way to go if you are looking for a greener way to supply electricity to your appliances. While it is most commonly seen as an energy source for the home, the 12V solar panel is most commonly found installed in motorhomes and caravans. This means that even when you are on the move in your motorhome, solar power can still fuel things like your fridge, TV, and even your waterpump. Another considerable benefit of these 12-volt solar panels is that they call for very less maintenance. Besides, they are not likely to break down or lose functionality easily, and their repair parts are handily available. The 12v solar panel arrays are the common solar array setups.

5.6.2 Servo motor 360 MG996R

The MG996R is a metal-gear servo motor with a maximum stall torque of 11 kg/cm. Like other RC servos, the motor rotates from 0 to 180 degrees based on theduty cycle of the PWM wave supplied to its signal pin. The MG996R 360° has the ability to rotate continuously through 360° in both directions. This makes this servo perfect for robotics or even the rotation of camera sliders!

The MG996R Digital Servo from Tower Pro features all-metal gearing, resulting in 10 kg of torque and 55 g of weight! This is a custom-made version of the MG996R servo, which can **continuously rotate 360° in both clockwise and counter-clockwise directions.** The MG996R is essentially an upgraded version of the famous MG995 servo and features upgraded shock-proofing and a redesigned PCB and IC control system that make it much more accurate than its predecessor. The gearing and motor have also been upgraded to improve dead bandwidth and centering!

Figure 15

They work great with our Raspberry Pi servo controllers. They're also great for the Arduino motor shields, or simply by wiring up an Arduino with the Servo library. You can use any servo code, hardware, or library to control these servos, so it's great for

beginners who want to make stuff move without building a motor controller with feedback and a gearbox, especially since it will fit in small places. These servos come with a selection of horns and hardware.

5.6.3 Raspberry pi 3 model B

The Raspberry Pi is a credit card-sized computer. The Raspberry Pi 3 Model B is the third generation of the Raspberry Pi. It is based on the BCM2837 system-on- chip (SoC), which includes a 1.2 GHz quad-core ARMv8 64-bit processor and a powerful Video Core IV GPU. The Raspberry Pi can run a full range of ARMGNU/Linux distributions, including Snappy Ubuntu Core, Debian, Fedora, and Arch Linux, as well as Microsoft Windows 10 IoT Core.

The Raspberry Pi 3 Model B is the first Raspberry Pi to feature onboard wireless and Bluetooth connectivity. It has the same form factor and connector locations as the older Raspberry Pi 2 Model B and Raspberry Pi Model B+. The Raspberry Pi was designed by the Raspberry Pi Foundation to provide an affordable platform for experimentation and education in computer programming. The RaspberryPi can be used for many of the things that a normal desktop PC does, including word processing, spreadsheets, high-definition video, games, and programming. USB devices such as keyboards and mice can be connected via the board’s four USB ports.

With its 0.1-inch-spaced GPIO header and small size, the Raspberry Pi also works as a programmable controller in a wide variety of robotics and electronics applications. It can also be combined with our A-Star 32U4 Robot Controller LV and the Raspberry Pi Bridge to make a great controller for a small robot.

Figure 16

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processer, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

In this project Raspberry pi 3 Model B has been used to control the entire process. The Raspberry Pi is a Broadcom BCM2835 SOC (system on a chip board). It comes equipped with 700 MHz, 512 MB of SDRAM and an ARM1176JZF-S core CPU. Raspberry Pi boars use only external data connectivity options with the USB 2.0 port. The Ethernet connection on the Raspberry Pi is the main gateway to interconnect with other devices and the internet in model B. This draws its power from a micro USB adapter, with a minimum range of 2.5 watts (500 MA). The graphics specialized chip speeds upimage calculations. This is built with Broadcom video core IV cable, which is useful if you want to run a game and video through your raspberry pi.

5.6.4 Raspberry pi camera

The Raspberry Pi Camera Board is a custom designed add-on module for Raspberry Pi hardware. It attaches to Raspberry Pi hardware through a custom CSI interface. The sensor has 5-megapixel native resolution in still capture mode. In video mode it supports capture resolutions up to 1080p at 30 frames per second. The camera module is light weight and small making it an ideal choice for mobile projects.

Figure 17

Features

5.6.4.1 Compatible with Raspberry Pi 4 Model B/3B+/3B/2B/Zero Wireless

5.6.4.2 5 Megapixel OV5647 Camera

5.6.4.3 Dimension: 24mmx23.5mmx8mm

5.6.4.4 Weight: 3g

5.6.4.5 Interface: CSI connector

5.6.4.6 Supported OS: Raspbian (latest version recommended)

5.6.4.7 Static Images Resolution: 2592×1944

5.6.5 Motor driver L293D

A motor driver is an integrated circuit chip that is usually used to control motors in autonomous robots. Motor drivers act as an interface between Arduino and the motors. The most commonly used motor driver ICs are from the L293 series, such as L293D, L293NE, etc. These ICs are designed to control two DC motors simultaneously. L293D consists of two H-bridges. H-bridge is the simplest circuit for controlling a low-current motor. We will be referring to the motor driver IC as L293D only. L293D has 16 pins. The L293D is a 16-pin IC with eight pins on each side dedicated to controlling a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor. L293D consists of two H-bridges. H-bridge is the simplest circuit for controlling a low-current motor.

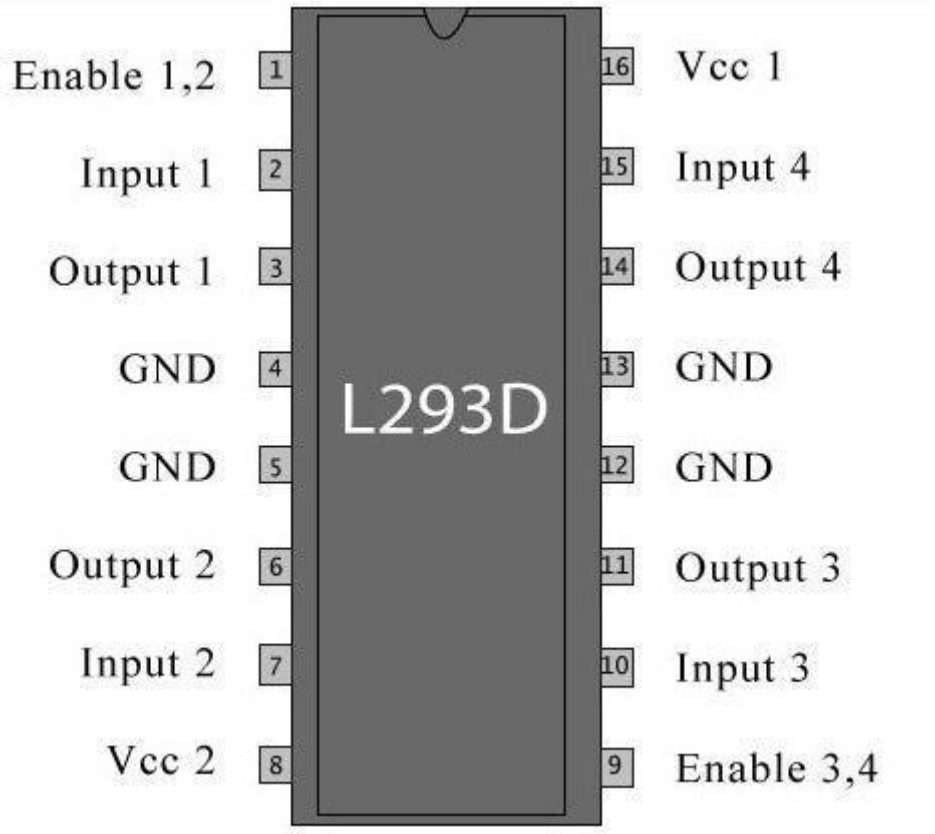

Figure 18

It works on the concept of the H-bridge. H-bridge is a circuit that allows the voltage to be flown in either direction. As you know, voltage needs to change direction to be able to rotate the motor in a clockwise or anticlockwise direction. Hence, H-bridge ICs are ideal for driving a DC motor. In a single L293D chip, there are two H-bridge circuits inside the IC that can rotate two dc motors independently. Due to its size, it is very often used in robotic applications for controlling DC motors. Given below is the pin diagram of a L293D motor controller. There are two enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with the left H-bridge, you need to enable pin 1 to high. And for the right H-bridge, you need to make the pin 9 inches high. If either pin1 or pin 9 goes low, then the motor in the corresponding section will stop working. It'slike a switch.

There are 4 input pins for l293d: pins 2 and 7 on the left, and pins 15 and 10 on the right, as shown on the pin diagram. Left input pins will regulate the rotation of the motor connected across the left side and right input for the motor on the right-hand side.

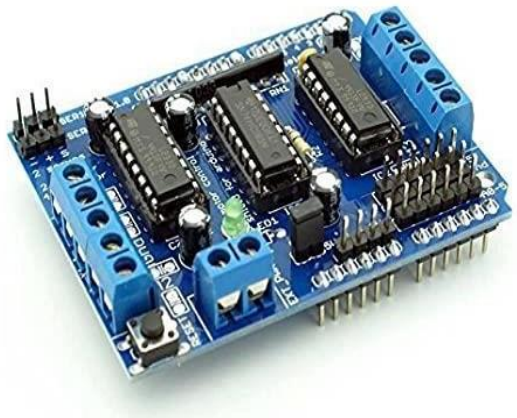

Figure 19

5.6.6 Water pump

The water pump can be defined as a pump that uses mechanical as well as hydraulic principles throughout a piping system to generate sufficient force for its future use. They have been approximately in one structure or another because of early civilization. At present, these pumps are used in a wide range of housing, farming, municipal, and manufacturing applications. The working principle of a water pump mainly depends on the positive displacement principle as well as kinetic energy to push the water. These pumps use AC or DC power for energising the motor of the water pump, whereas others can be powered by other kinds of drivers like gasoline engines or diesel engines. The water pump is a portable device and can be used in several household applications. These pumps are used for pumping huge amounts of water from one place to another. The main purpose of a water pump is versatility. A quality pump that can be carefully selected may be perfect for draining water from a low-flooded region, refilling the swimming pool and bathtub, and circulating pesticides or fertilisers. The collection of water pumps is very large; therefore, while selecting a strong and consistent one, one should think about the requirements. Irrigation pumps are used to pump water from a lower to a higher level from which the water then flows through channels to the fields requiring irrigation (lift operation) or to raise it to the required pressure head so that it canbe sprayed on the fields via piping systems.

Figure 20

5.6.7 Battery

A battery is a device that stores chemical energy and converts it to electrical energy. The chemical reactions in a battery involve the flow of electrons from one material (electrode) to another, through an external circuit. The flow of electrons provides an electric current that can be used to do work. The solar energy can be stored in this battery and used when it needs.

Figure 21

5.6.8 Audio Devices

The working principle of an Audio devices or speaker is, when an alternating current electrical audio signal from an audio device fed to the coil, immediatelythe copper coil behaves as an electromagnet and generates the magnetic pole. The suitable crop names can be heard using any 3.5mm jack wired or wirelessspeaker and headphone.

Figure 22

5.7 TYPES OF SOUND USED FOR ANIMAL REPELLANT

- **Tiger**

Tigers, like the majority of Animals are terrified of fire. The use of fire to keep tigers at Bay has been practised for decades by big cat "tamers." Tigers are also frightened by the strange sounds that they never heard before.

- **Elephant**

Elephants are afraid of bees. The largest animal on land is so terrified of a tiny insect that it will flap its ears, stir up dust and make noises when it hears the buzz of a beehive. A bee's stinger can't penetrate the thick hide of an elephant.

- **Monkey**

Monkeys are scared of snakes. Keep real-looking plastic snakes on your house's roof or boundary wall. Loud, heavy noise, the bursting of crackers, or their sound track will force the monkeys to leave any premises.

- **Wild Pigs**

Sounds or alarms that could scare away wild boar include the barking of huntingdogs, Shotgun shots, Distress calls from another wild hog.

- **Deer**

Auditory deterrents can repel deer with their noise and include noisemakers like gas or propane exploders, whistles, and ultrasonic devices. Gas or propane exploders produce loud banging noises that frighten deer away and have been used to help protect orchards, row crops, and truck crops.

- **Rabbit**

Rabbits are highly sensitive to thunder, loud bangs from fireworks, and very noisy children. They're also likely to run away when you turn on you hoover. Typical signs of distress in rabbits include: Staying motionless / playing dead.

An **animal repellents** is any thing or method that keeps certain animals away from certain objects, areas, people, plants, or other animals. To this end, living organisms emit special semiochemicals naturally; humans purposely make use of some of those and also design other repellents. Repellents generally work by taking advantage of an animal's natural aversion to something, and often the thing chosen is something that the animal has learned to avoid (or instinctively avoids) in its natural environment. Chemical repellents fall into two main categories, odor and taste. The former work better in the warm season and the latter, which ward off an animal only after it eats, in the cold season. (For example, the smell of the lawn fertilizer Milorganite is claimed to make it an effective repellent.) Such repellents mimic natural substances that deter animals and/or are designed to be so irritating to a specific animal or type of animal that it will avoid the protected object or area. Contactplant-origin repellents such as pepper, peppermint, tarragon, garlic, various essential oils, and castor oil, as well as diatomaceous earth and putrescent egg solids, are examples. Further, some repellents function by inducing fear in the target animal.Sucha repellent may contain animal urine, dried blood, or hair.

Some animals will avoid anything that has the odour of the urine of their predators. Tiger urine is thus very effective at keeping animals away hair. Some animals will avoid anything that has the odour of the urine of their predators. Tiger urine is thus very effective at keeping animals away. Coyote urine has gained currency as a deer repellent. Wolf urine is used to repel moose. Used cat litter is also effective. Domestic dogs can be repelled by vinegar. Other repellents are not chemical. A simple electrified or barbed-wire fence can mechanically repel livestock or predatory animals. Some electrical repellent systems have been tested against sharks. High-frequency whistles are used on vehicles to drive deer away from highways, and similar devices are used to deter certain types of insects or rodents. Repellents of this kind for domestic cats and dogs include ultrasonic devices, which emit a high-frequency noise that does not affect humans. These types of non-chemical repellents are controversial, both

because their effectiveness varies from animal to animal and because there have been few scientific studies conducted to prove that they work. They are, however, safeand humane, as are motion-activated sprinklers and electronic pet barriers, the latter of which are used by pet owners to confine their own pets to designated areas. Flashing lights are used to repel lions in Kenya.

The ideal repellent is completely specific for the target animal; that is, it drives away the animal that one wishes to repel without affecting or harming any other animals or people. One type of animal repellent may be effective for raccoons, while another typemay be more effective for skunks. To this end, living organisms emit special semiochemicals naturally; humans purposely make use of some of those and also design other repellents. Repellents generally work by taking advantage of an animal's natural aversion to something, and often the thing chosen is something that the animal has learned to avoid (or instinctively avoids) in its natural environment. Chemical repellents fall into two main categories, odor and taste. The former work better in the warm season and the latter, which ward off an animal only after it eats, in the cold season. (For example, the smell of the lawn fertilizer Milorganite is claimed to make it an effective repellent.) Such repellents mimic natural substances that deter animals and/or are designed to be so irritating to a specific animal or type of animal that it will avoid the protected object or area. Contactplant-origin repellents such as pepper, peppermint, tarragon, garlic, various essential oils, and castor oil, as well as diatomaceous earth and putrescent egg solids, are examples. Further, some repellents function by inducing fear in the target animal.Sucha repellent may contain animal urine, dried blood, or hair.

CHAPTER- 6

RESULT

Agricultural production is an essential element in the development of human civilization. To prevent crop losses, some protection and warning systems need to be deployed to detect and drive away animals. In this project, we tend to provide protectionfrom the attacks of wild animals, thus minimising the probable loss to the farmer. Thisproject is used to detect intrusion around the field by animals. Then captures the imageof the respective animal and sends an alarming sound. A timid sound is produced basedon the animals, which will drive the animals off the field as soon as possible. In additionto that, water is sprayed on the animal to drive it quickly. The Raspberry Pi 3 Model Bis used. The main advantage of the Raspberry Pi camera over a USB webcam is that it is able to make use of the graphics processing capability of the Broadcom CPU. An audio device can be connected to the system to provide a timid sound to keep animals away. Figure 18 is the hardware model of the proposed system.

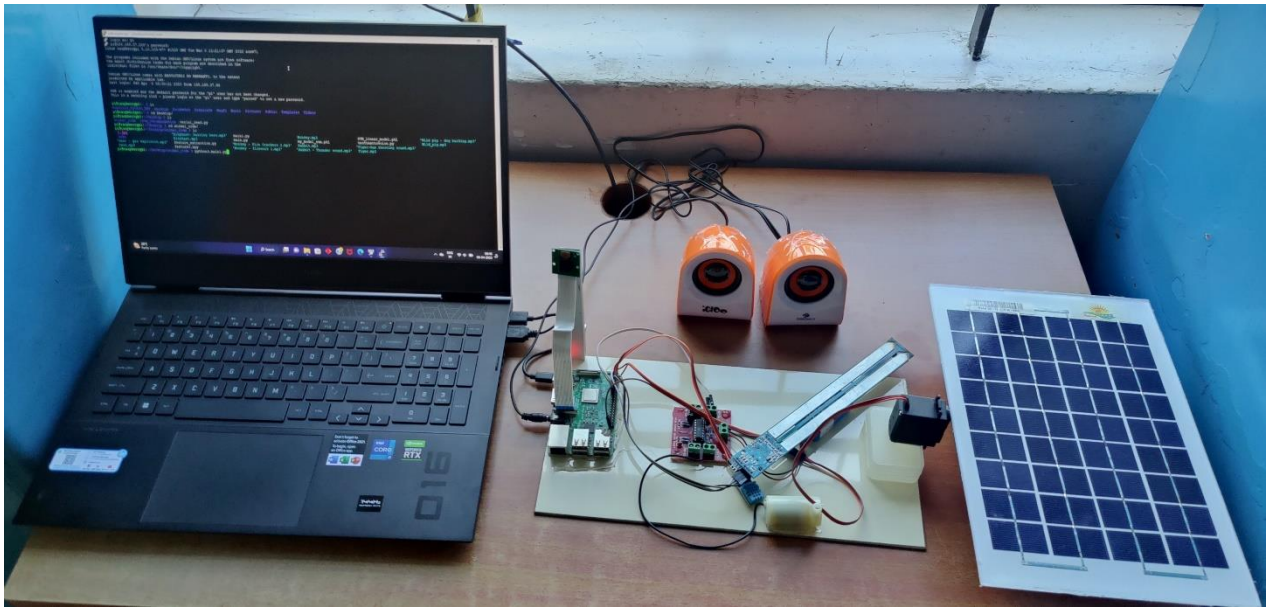

Figure 23

By connecting the device to an advanced IP scanner application, the hardware can be executed using the Putty software. The proposed method was composed of feature extraction and classification. In the proposed system we are using three machine learning algorithms. The GLCM algorithm is used for parameter detection. These statistics provide information about the texture of an image. They provide statistics like contrast, correlation, energy, homogeneity. The SVM algorithm is used for both classification and regression. In the image dataset, there will be a collection of digital images for every animals. Once the image is set, pre-processing begins. Preprocessingis the process of preparing the raw data and making it suitable to the model. After pre processing, this raw data is converted into numerical features in feature extraction. Once the model is extracted , it is trained using SVM algorithm. After completion the model is saved for testing. In the SVM Figure 10 algorithm, there is already a trained model. Based on the trained image dataset , if we provide input. It recognises the trained dataset and produces output. If the camera detects the animal that is already trained, it produces a timid sound to repel it away.

In dual axis solar tracking system the Logistic regression algorithm is applied to rotate the panel according to the mentioned angle. For this model, training and testing will be done based on this logistic regression algorithm. So it will be easy to position the solar tracker with a servo motor at the desired angle. The testing and training data will be given to input them and it computes the data with regression coefficients using Sigmoid function. After finding a relationship between training and testing data, the object position can be determined. By using this tracking system, power would be provided to the water pump for irrigation process. Once the humidity value reaches below the predetermined value, power is supplied to motor driver circuit for driving the water pump for irrigation.

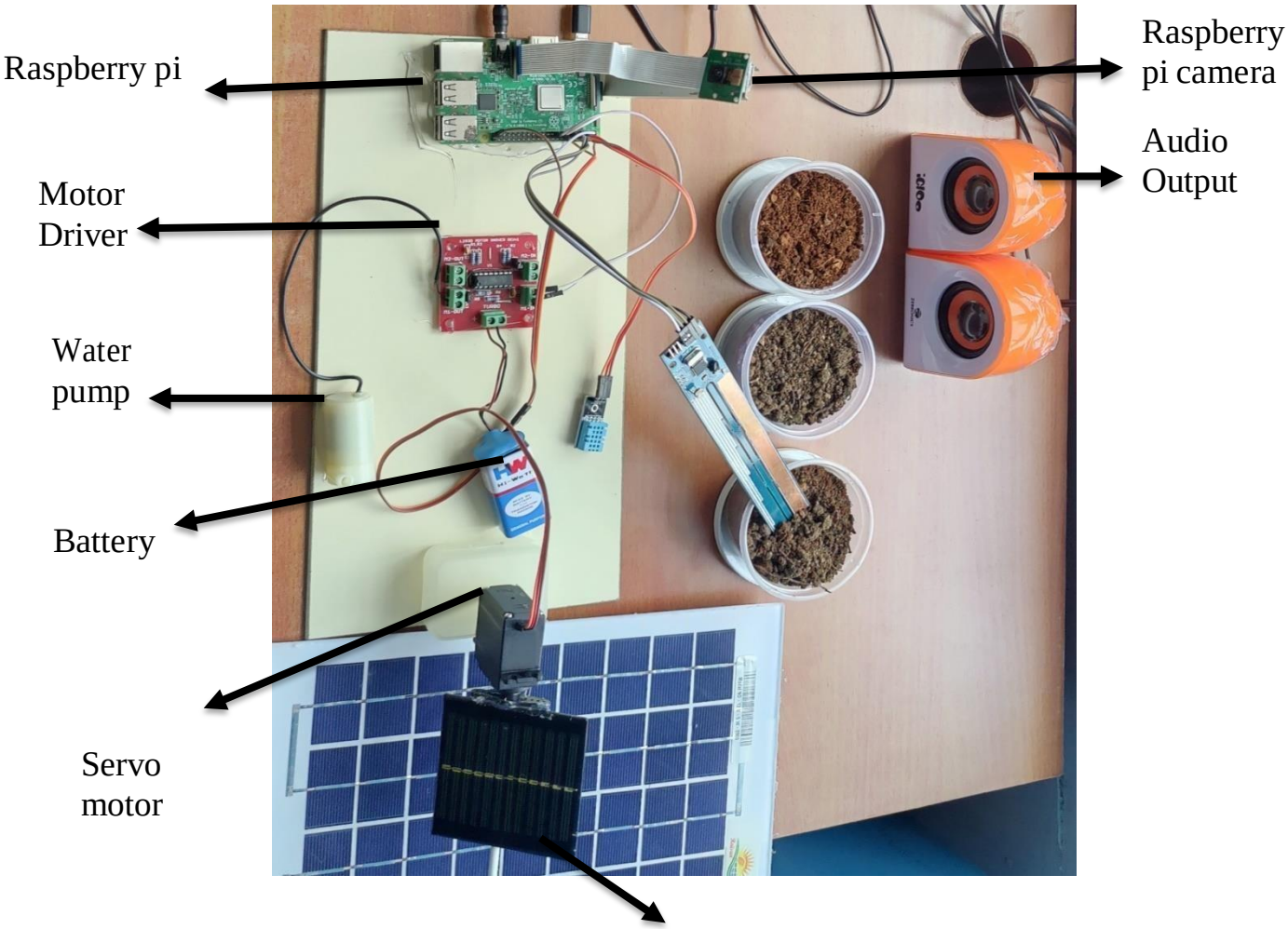

Figure 24

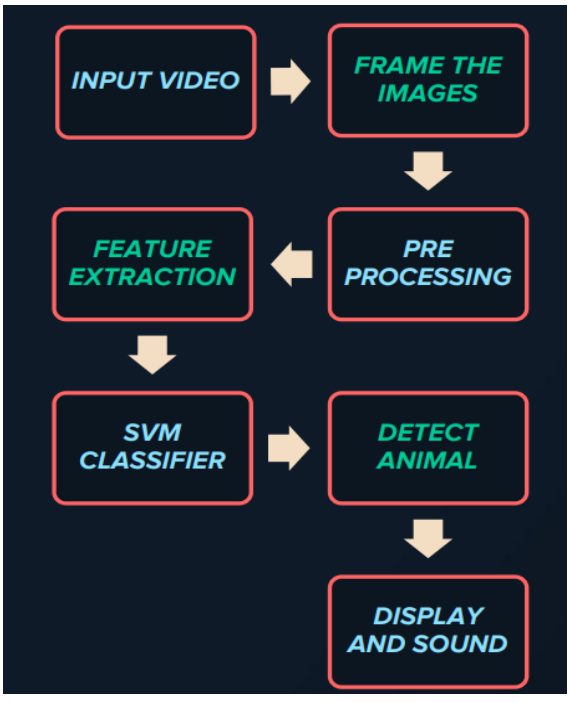

Figure 25

By connecting the device to an advanced IP scanner application, the hardware can be executed using the Putty software. Sample 1, if a camera detects an elephant, a buzzingbee sound is played on audio devices to scare it away. The water pump is also turned on bythe solar power.

Figure 26

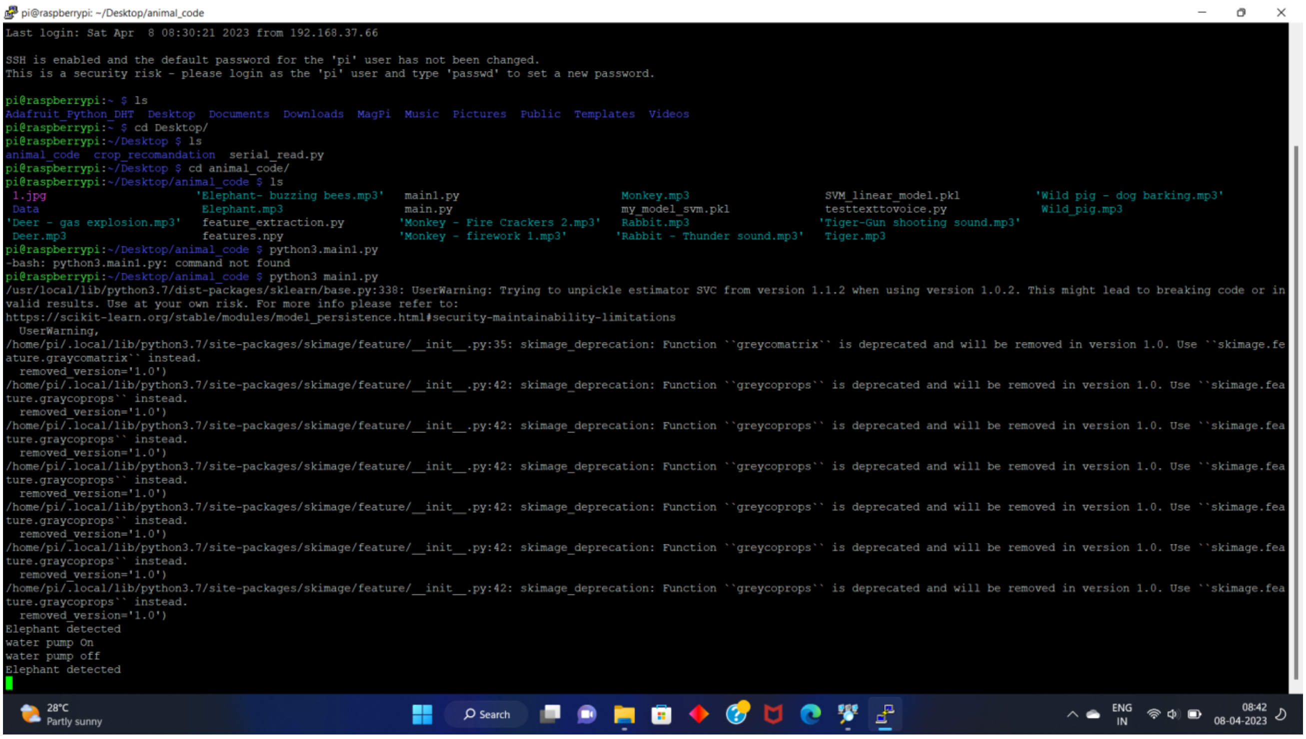

Figure 27

Sample 2, if a camera detects a Tiger, an Gun shooting sound is played on audio devices to scare it away. The water pump is also turned on bythe solar power.

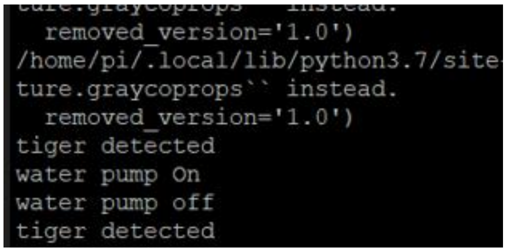

Figure 28

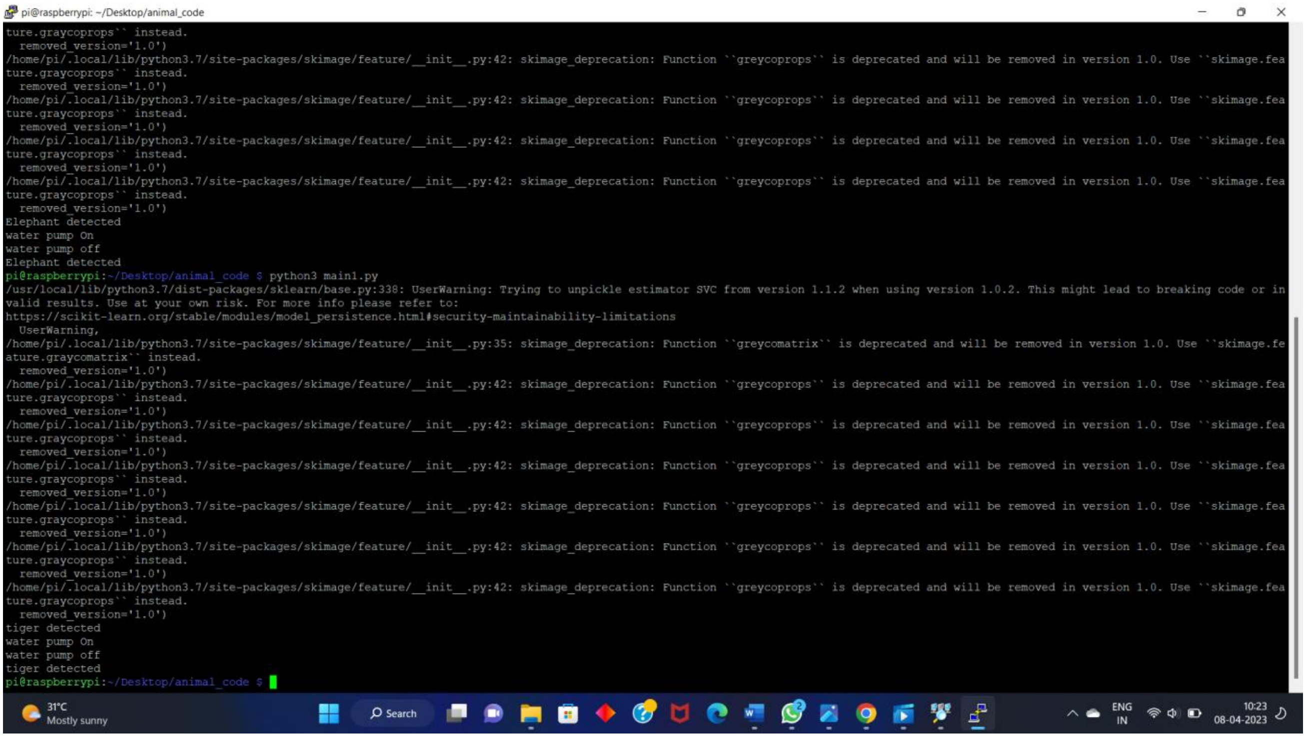

Figure 29

Sample 3, if a camera detects a Wild pig, Dog Barking sound is played on audio devices to scare it away. The water pump is also turned on by the solar power.

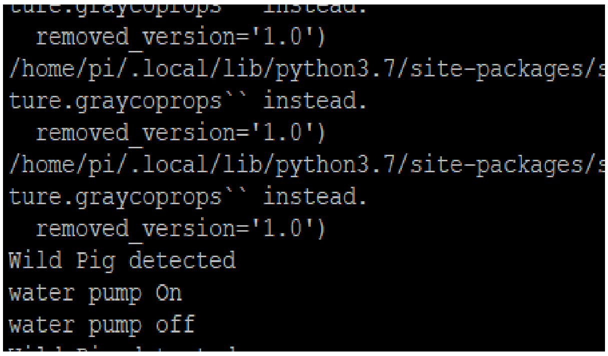

Figure 30

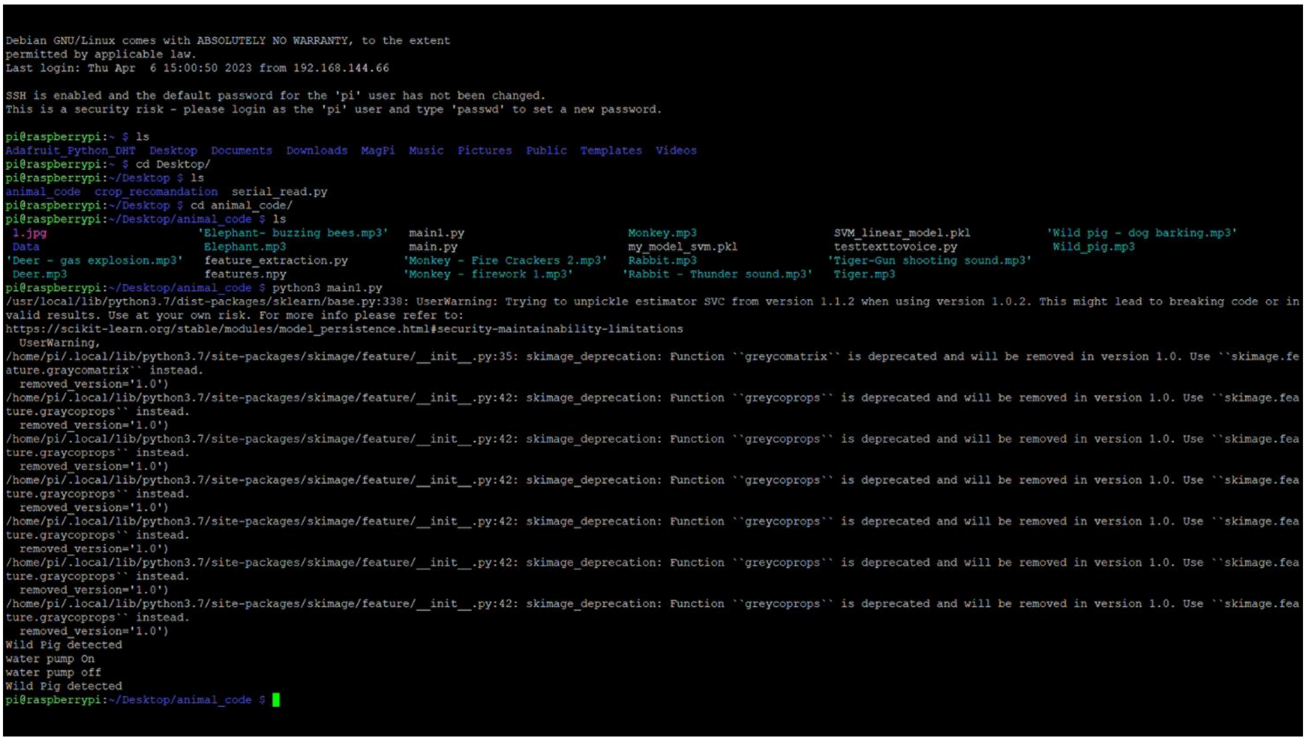

Figure 31

CHAPTER – 7

CONCLUSION

Agricultural farm security is a widely needed technology nowadays. In order to accomplish this, A vision-based system is proposed and implemented using Python and OpenCV, and an Animal Repellent System to blow out the animals. The implementation of the application required the design and development of a complex system for intelligent animal repulsion that integrates newly developed software components and allows to recognize the presence and species of animals in real time and also to avoid crop damages caused by the animals. Based on the category of the animal detected, the edge computing device executes its Animal Recognition model to identify the target, and if an animal is detected, it sends back a message to the Animal Repelling Module, including the type of ultrasound to be generated according to the category of the animal. The proposed GLCM was evaluated using the created animal database. The overall performance were obtained using different numbers of training images and test images. The experimentally obtained. The results of the performed experiments show that the proposed system gives the best recognition rate fora greater number of input training images (accuracy of about 98%). This project presented a real-time monitoring solution based on AI technology to address the problems of crop damage caused by animals. This technology can help farmers and agronomists in theirdecision-making and management process. The objective of our project is to provide protection from the attacks of the wild animals, thus minimising the probable loss to thefarmer. To detect intrusions around the field. To capture the image of the intruder and classify them using image processing. Taking suitable action based on the type of intruder and repelling them by providing sound.

CHAPTER – 8

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