Visvesvaraya Technological University, Belagavi.

PROJECT REPORT

on

"IOT SOLUTIONS FOR CROP PROTECTION AGAINST WILD ANIMAL ATTACKS"

Project Report submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Engineering

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CERTIFICATE

This is to Certify that the dissertation work **"Iot Solutions for Crop Protection Against Wild Animal Attacks"** carried out by Anu T S, Anusha GL, Jayashree, Namitha D, USN: 1CR16EC016, 1CR16EC018, 1CR16EC055, 1CR16EC091 bonafide students of **CMRIT** in partial fulfillment for the award of **Bachelor of Engineering** in **Electronics and Communication Engineering** of the **Visvesvaraya Technological University, Belagavi,** during the academic year **2019-20**. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said degree.

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Chapter 1

INTRODUCTION

Crop damage caused by animal attacks is one of the major threats in reducing the crop yield. Due to the expansion of cultivated land into previous wildlife habitat, crop raiding is becoming one of the most conflicts antagonizing human wildlife relationships. The current methods used to counter this problem include the use of electrified welded mesh fences (usually 30cm in the ground), chemicals or organic substances and gas cannons. Other traditional methods applied by farmers include the use of Hellikites, Ballons, Shot/Gas guns, String & stone, etc. These solutions are often cruel and ineffective. They also require a vast amount of installation and maintenance cost and some of the methods have environmental pollution effect on both humans and animals.

On the other hand, the chemical products used to prevent these animal attacks have an application cost per hectare and their effectiveness is dependent on weather condition, as rain may cause a dilution effect. Technology assistance at various stages of agricultural processes can significantly enhance the crop yield. Sensor networks express a substantial improvement over traditional invasive methods of monitoring. Our proposed method is based on an animal friendly ultrasounds generator, which does not produce physical or biological harm to the animals nor sounds audible to humans.

1.1 EXISTING SYSTEM

The wild life camera DVR utilizes infrared technology which will capture great footage at any time of the day or nights as well as being supplied in a sturdy weatherproof and camouflaged box. Record full color video footage or 8 MP photographs produced by the wild life camera is transferred to a SD card and then review on a PC. The built in rechargeable battery can last (depending on the activity) up to 2 weeks. Existing technology has following features -Motion triggered and adjustable infrared (PIR) sensitivity -Rechargeable battery life 2 weeks -2.5” LCD Screen -Auto switch color images in day/B&W night images -SD card slot (2 GB) -Multi shot of 1 - 3 pictures -Programmable video length.

1.1.1 DISADVANTAGES

- No detection of animal in different angles
- Security process is low
- Maintenance level is low

1.2 PROPOSED SYSTEM

- In this work, background subtraction method is used for detecting the animal.

- This particular technique is used to separate the object from the image.
- Whereas, object shaping is identified using blob method.
- This method is general and fastest technique in machine vision used for identifying the image region.
- For extracting the targeted animal's details from background, this approach can be used.
- In our proposed work, when the animal enter into the farm area, the PIR and ultrasonic sensor detect the presence of the animal and send an input signal to the controller.
- Immediately, the APR board will be on, and the sound is played to divert the animal.
- During night time the flash light will be on and the message will be send to the forest department and a call to the farmer.

1.2.1 ADVANTAGES

- Fast incident detection
- Very convenient to detect object.
- Cover over all area rather than existing method

Chapter 2

LITERATURE SURVEY

2.1 TITLE: Imaging of crop canopies for the remote diagnosis and quantification of field Responses

AUTHOR: Hitanshi P. Prajapati, Yatharth B. Mr. Manmohan Singh

YEAR: 2017

In this paper, Application of crop production and protection materials is a crucial component in the high productivity of Indian agriculture. Agricultural chemical application is frequently needed at specific times and locations for accurate site specific management of crop pests to be easy. Piloted agricultural aircraft are typically used to treat large, unobstructed, continuous acreage crops and are not as efficient when working over obstructed plots. An Unmanned Aerial Vehicle(UAV), which can be directly remotely controlled or fly autonomously based on pre-programmed flight plans, may be used to make timely and efficient applications over these small or big area plots. This research developed a low volume spray system for use on a fully autonomous UAV to apply crop protection products on specified crop areas' pests by Image Processing using raspberry Pi and camera.

2.2 TITLE: The Exploitation of Rice Paddy Field and Its Ecological Protection

AUTHOR: Ping Yang, Wei Zhu

YEAR: 2013

As the typical agricultural ecological section, the constructed wetland of rice paddy field is one of the most important environmental assets of human being, it's closely interrelated to our life and social development. However, with the development of economic, a large area of irrational exploitation and utilization occurred in the wetlands by human being, resulting a decreasing of natural wetlands and constructed wetlands like rice paddy field. In the process of modernization, the reduction of wetland diversity is one of the environmental problems that rivers and lakes faced. The protection of biodiversity and habitats in rice paddy fields have been paid broad attention and there are already some large-scale protection projects exited. However, the artificial protection of rice paddy field cannot directly improve it's production and is difficult to popularize widely. This article take an example of rice paddy field's ecological protection in lake Biwa, analysing the main roles' function in the utilizing and development of rice paddy field, building the pattern of biodiversity in paddy field and analyzed its effects to the environment of wetland's ecology and village, providing a theoretical basis for the policymaking in protection of rice paddy field.

2.3 TITLE: Extracting Pest Risk Information from Risk Assessment Documents

AUTHOR: Newton Glen, Oksana Korol, Levesque Andre, Favrin Robert, Graefenham Tom

YEAR: 2019

Outbreaks of plant pests and pathogens have the potential to significantly harm the Canadian economy, damage the environment, detrimentally affect the health of citizens, and threaten national food security. Loss of trees caused by the Emerald Ash Borer pest had a significant public health impact due to an increase in mortality related to cardiovascular and respiratory tract illness. Outbreaks of UG99 wheat rust strain can cause up to 100% crop losses of wheat and is viewed as a potential worldwide disaster with massive implications for global food security. In Canada, an outbreak of Potato Wart disease in 2000 resulted in $280 million in costs to the provincial economy of Prince Edward Island. The Canadian Food Inspection Agency (CFIA) has completed decades of risk analyses for various crop commodities and specific pests/pathogens. These analyses characterize the risk of exotic pests to Canada and support regulatory decision-making and response actions.

2.4 TITLE: Decision Support System for Plant and Crop Treatment and Protection Based on Wireless Sensor Networks

AUTHOR: Zoran Stamenković, Siniša Randjić, Ignacio Santamaria, Dušan Marković, Steven Van, Vaerenbergh, and Uroš Pešović

YEAR: 2017

A decision support system (DSS) able to protect/treat plants and crops taking into account the temporal and spatial variability of physical, environmental, and agricultural parameters has been described. It is based on remote sensing and the most sophisticated machine learning techniques Gaussian processes and deep neural networks. An example of knowledge extraction and actionable rule definition has been presented too.

Chapter 3

SOFTWARE

3.1. BLOCK DIAGRAM – SOFTWARE UNIT:

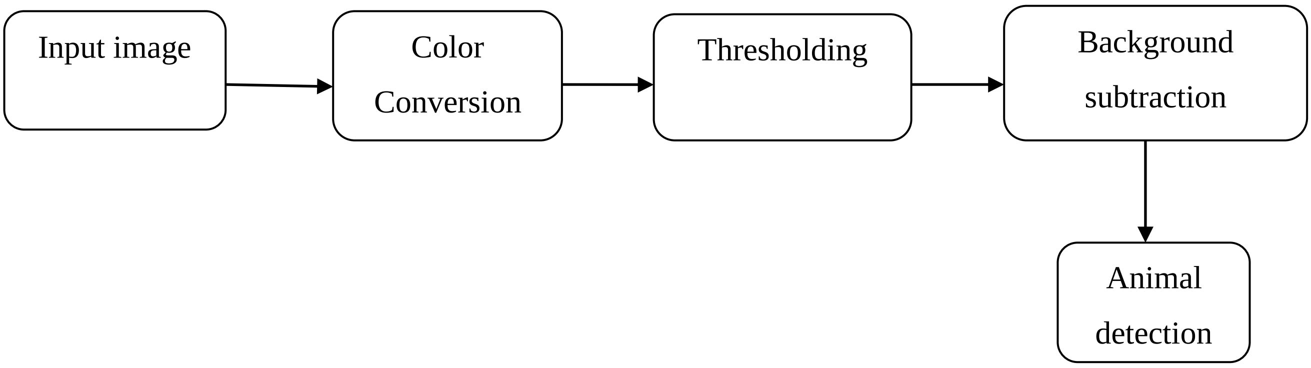


Fig 1 Proposed System unit

3.2 IMAGE ACQUISITION:

The first stage of any vision system is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even with the aid of some form of image enhancement. Digital imaging or digital image acquisition is the creation of a digitally encoded representation of the visual characteristics of an object, such as a physical scene or the interior structure of an object. The term is often assumed to imply or include the processing, compression, storage, printing, and display of such images. A key advantage of a digital image, versus an analog image such as a film photograph, is the ability make copies and copies of copies digitally indefinitely without any loss of image quality.

Digital imaging can be classified by the type of electromagnetic radiation or other waves whose variable attenuation, as they pass through or reflect off objects, conveys the information that constitutes the image. In all classes of digital imaging, the information is converted by image sensors into digital signals that are processed by a computer and made output as a visible-light image. For example, the medium of visible light allows digital photography (including digital videography) with various kinds of digital cameras (including digital video cameras). X-rays allow digital X-ray imaging (digital radiography, fluoroscopy, and CT), and gamma rays allow digital gamma ray imaging (digital scintigraphy, SPECT, and PET). Sound allows ultrasonography (such as medical ultrasonography) and sonar, and radio waves allow radar. Digital imaging lends itself well to image analysis by software, as well as to image editing (including image manipulation).

3.2.1 2D Image Input:

The basic two-dimensional image is a monochrome (greyscale) image which has been digitised. Describe image as a two-dimensional light intensity function f(x,y) where x and y are spatial coordinates and the value of f at any point (x, y) is proportional to the brightness or grey value of the image at that point. A digitised image is one where spatial and greyscale values have been made discrete. Intensity measured across a regularly spaced grid in x and y directions intensities sampled to 8 bits (256 values).

3.3 GRAY IMAGE:

In digital photography, computer-generated imagery, and colorimetry, a grayscale or greyscale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Grayscale images, a kind of black-and-white or gray monochrome, are composed exclusively of shades of gray. The contrast ranges from black at the weakest intensity to white at the strongest.

Grayscale images are distinct from one-bit bi-tonal black-and-white images which, in the context of computer imaging, are images with only two colors: black and white (also called bilevel or binary images). Grayscale images have many shades of gray in between.

Grayscale images can be the result of measuring the intensity of light at each pixel according to a particular weighted combination of frequencies (or wavelengths), and in such cases they are monochromatic proper when only a single frequency (in practice, a narrow band of frequencies) is captured. The frequencies can in principle be from anywhere in the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.).

A colorimetric (or more specifically photometric) grayscale image is an image that has a defined grayscale colorspace, which maps the stored numeric sample values to the achromatic channel of a standard colorspace, which itself is based on measured properties of human vision.

If the original color image has no defined colorspace, or if the grayscale image is not intended to have the same human-perceived achromatic intensity as the color image, then there is no unique mapping from such a color image to a grayscale image.

3.3.1 Grayscale As Single Channels Of Multichannel Color Images:

Colour images are often built of several stacked colour channels, each of them representing value levels of the given channel. For example, RGB images are composed of three independent channels for red, green and blue primary color components; CMYK images have four channels for cyan, magenta, yellow and black ink plates, etc.

Here is an example of color channel splitting of a full RGB color image. The column at left shows the isolated color channels in natural colors, while at right there are their grayscale equivalences:

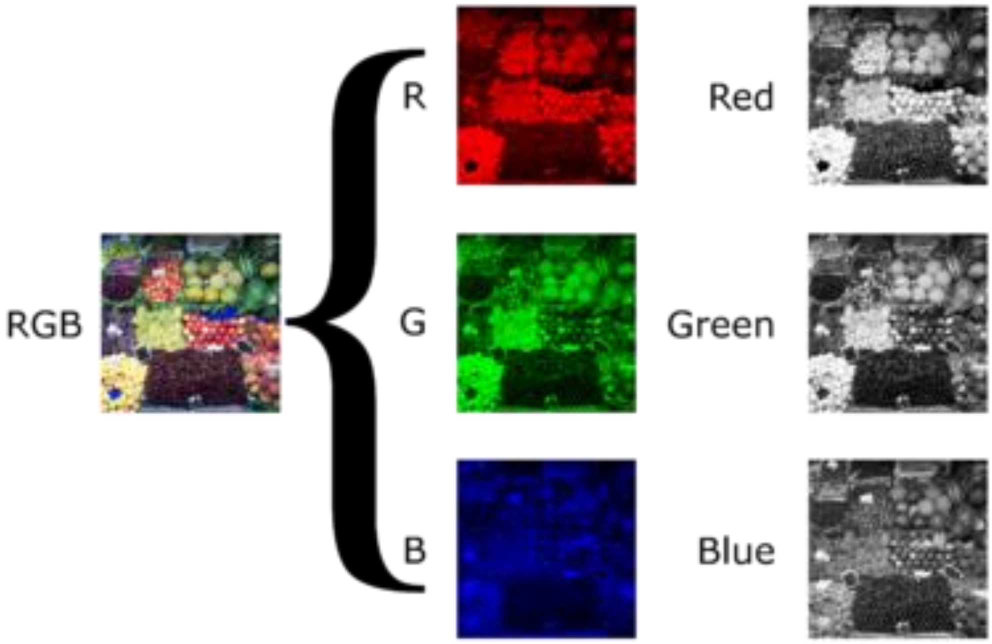


Fig 2 Conversion RGB to Gray

The reverse is also possible: to build a full color image from their separate grayscale channels. By mangling channels, using offsets, rotating and other manipulations, artistic effects can be achieved instead of accurately reproducing the original image.

3.3.2 THRESHOLDING:

Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. Image thresholding is most effective in images with high levels of contrast.

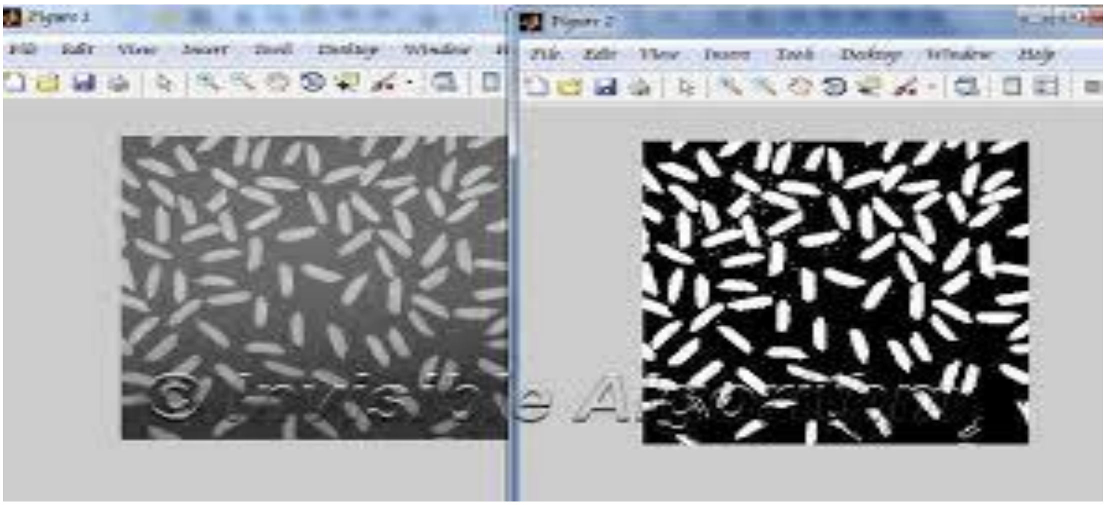


Fig 3. Thresholding

3.3.3 BACKGROUND SUBRACTION:

Background subtraction, also known as Foreground Detection, is a technique in the fields of image processing and computer vision wherein an image's foreground is extracted for further processing (object recognition etc.). Generally an image's regions of interest are objects (humans, cars, text etc.) in its foreground. Background subtraction is a widely used approach for detecting moving objects in videos from static cameras. The rationale in the approach is that of detecting the moving objects from the difference between the current frame and a reference frame, often called "background image", or "background model.

3.4 SYSTEM IMPLEMENTATION:

3.4.1 Data Analysis and Visualization:

MATLAB provides tools to acquire, analyze, and visualize data, enabling you to gain insight into your data in a fraction of the time it would take using spreadsheets or traditional programming languages. You can also document and share your results through plots and reports or as published MATLAB code

3.4.2 Acquiring Data:

MATLAB lets you access data from files, other applications, databases, and external devices. You can read data from popular file formats such as Microsoft Excel; text or binary files; image, sound, and video files; and scientific files such as net CDF and HDF. File I/O functions let you work with data files in any format.

Using MATLAB with add-on products, you can acquire data from hardware devices, such as your computer's serial port or sound card, as well as stream live, measured data directly into MATLAB for analysis and visualization. You can also communicate with instruments such as oscilloscopes, function generators, and signal analyzers.

3.4.3 Analyzing Data:

MATLAB lets you manage, filter, and preprocess your data. You can perform exploratory data analysis to uncover trends, test assumptions, and build descriptive models. MATLAB provides functions for filtering and smoothing, interpolation, convolution, and fast Fourier transforms (FFTs). Add-on products provide capabilities for curve and surface fitting, multivariate statistics, spectral analysis, image analysis, system identification, and other analysis tasks.

3.4.4 Visualizing Data:

MATLAB provides built-in 2-D and 3-D plotting functions, as well as volume visualization functions. You can use these functions to visualize and understand data and communicate results. Plots can be customized either interactively or programmatically. The MATLAB plot gallery provides examples of many ways to display data graphically in MATLAB. For each example, you can view and download source code to use in your MATLAB application.

3.4.5 Programming and Algorithm Development:

MATLAB provides a high-level language and development tools that let you quickly develop and analyze algorithms and applications.

3.4.6 The MATLAB Language:

The MATLAB language provides native support for the vector and matrix operations that are fundamental to solving engineering and scientific problems, enabling fast development and execution. With the MATLAB language, you can write programs and develop algorithms faster than with traditional languages because you do not need to perform low-level administrative tasks such as declaring variables, specifying data types, and allocating memory. In many cases, the support for vector and matrix operations eliminates the need for for-loops. As a result, one line of MATLAB code can often replace several lines of C or C++ code. MATLAB provides features of traditional programming languages, including f low control, error handling, and object-oriented programming (OOP). You can use fundamental data types or advanced data structures, or you can define custom data types. You can produce immediate results by interactively executing commands one at a time. This approach lets you quickly explore multiple options and iterate to an optimal solution. You can capture interactive steps as scripts and functions to reuse and automate your work. MATLAB add-on products provide built-in algorithms for signal processing and communications, image and video processing, control systems, and many other domains. By combining these algorithms with your own, you can build complex programs and applications.

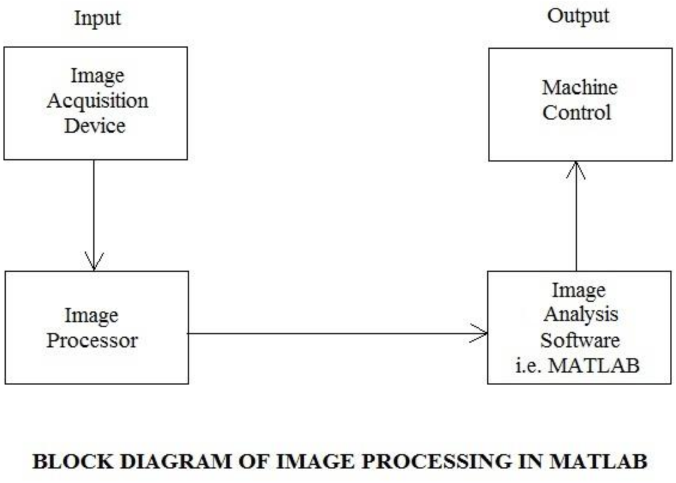


Fig 4. Block Diagram of Image Processing in Matlab

3.4.7 Development Tools:

MATLAB includes a variety of tools for efficient algorithm development, including:

3.4.7.1 Command Window –Lets you interactively enter data, execute commands and programs, and display results

3.4.7.2 MATLAB Editor–Provides editing and debugging features, such as setting break points and stepping through individual lines of code

3.4.7.3 Code Analyzer–Automatically checks code for problems and recommends modifications to maximize performance and maintainability

3.4.7.4 MATLAB Profiler–Measures performance of MATLAB programs and identifies areas of code to modify for improvement

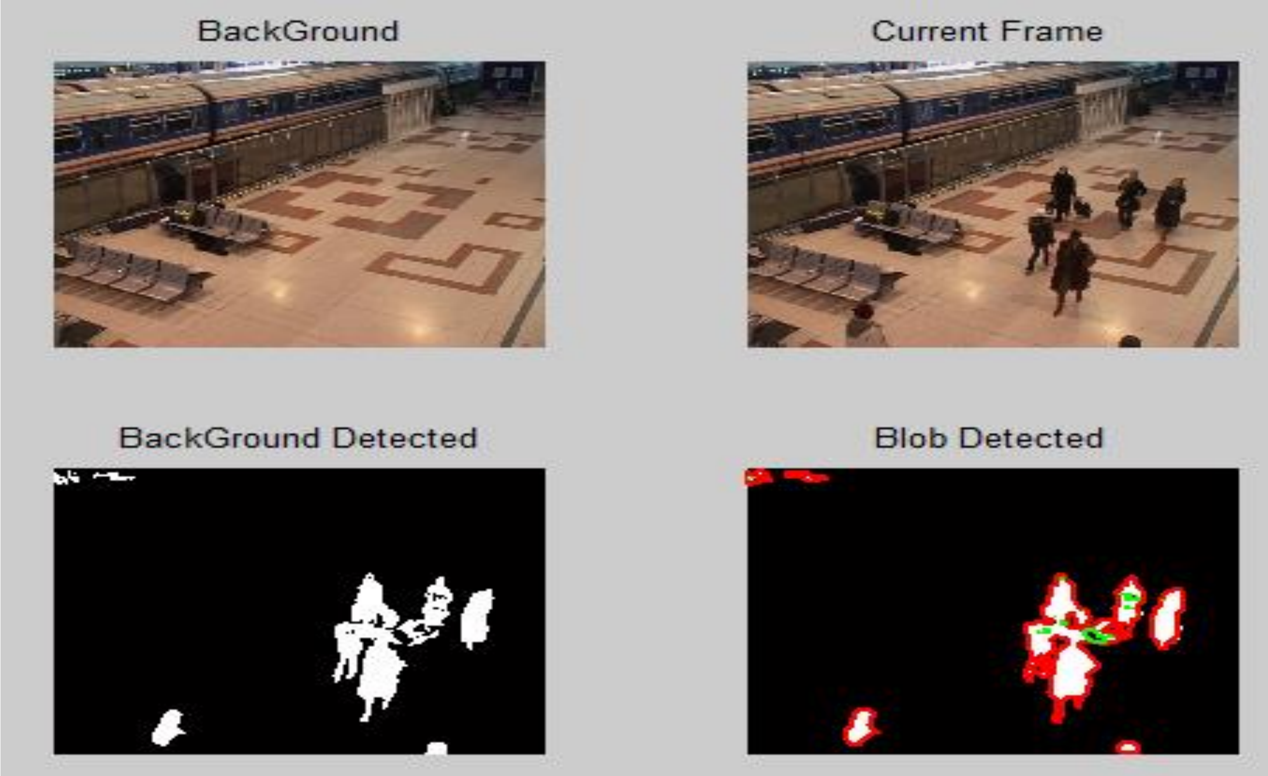


Fig 5. Development Tool

3.5 SOFTWARE DESCRIPTION

3.5.1 MATLAB:

MATLAB is a programming language developed by Math Works. It started out as a matrix programming language where linear algebra programming was simple. It can be run both under interactive sessions and as a batch job. MATLAB(matrix laboratory) is a fourth generation high-level programming language and interactive environment for numerical computation, visualization and programming. MATLAB is developed by Math Works. It allows matrix manipulations; plotting of functions and data; implementation of algorithms; creation of user interfaces; interfacing with programs written in other languages, including C, C++, Java, and FORTRAN; analyse data; develop algorithms; and create models and applications. It has numerous built in commands and math functions that help you in mathematical calculations, generating plots and performing numerical methods.

3.5.2 MATLAB'S POWER OF COMPUTATIONAL MATHEMATICS:

MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly:

- Dealing with Matrices and Arrays
- Plotting and graphics
- Linear Algebra
- Algebraic Equations
- Non-linear Functions
- Statistics
- Data Analysis
- Calculus and Differential Equations
- Numerical Calculations
- Integration
- Transforms
- Curve Fitting

3.5.3 FEATURES OF MATLAB:

It is a high-level language for numerical computation, visualization and application development. It also provides an interactive environment for iterative exploration, design and problem solving. It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations. It provides built-in graphics for visualizing data and tools for creating custom plots. MATLAB's programming interface gives development tools for improving code quality, maintainability and maximizing performance. It provides tools for building applications with custom graphical interfaces. It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

3.5.4 USES OF MATLAB:

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams.

It is used in a range of applications including:

- signal processing and Communications
- image and video Processing

- control systems
- test and measurement
- computational finance
- computational biology

3.5.5 DIGITAL IMAGE PROCESSING:

Digital image processing deals with manipulation of digital images through a digital computer. It is a subfield of signals and systems but focus particularly on images. DIP focuses on developing a computer system that is able to perform processing on an image. The input of that system is a digital image and the system process that image using efficient algorithms, and gives an image as an output. The most common example is Adobe Photoshop. It is one of the widely used application for processing digital images.

3.5.5.1 WORKING:

Fig 6. Digital Image Processing

In the above figure, an image has been captured by a camera and has been sent to a digital system to remove all the other details, and just focus on the water drop by zooming it in such a way that the quality of the image remains the same.

3.5.6 SIGNAL PROCESSING:

Signal processing is a discipline in electrical engineering and in mathematics that deals with analysis and processing of analog and digital signals , and deals with storing , filtering , and other operations on signals. These signals include transmission signals , sound or voice signals , image signals , and other signals e.t.c.

Out of all these signals , the field that deals with the type of signals for which the input is an image and the output is also an image is done in image processing. As it name suggests, it deals with the processing on images. It can be further divided into analog image processing and digital image processing.

3.5.7 ANALOG IMAGE PROCESSING:

Analog image processing is done on analog signals. It includes processing on two dimensional analog signals. In this type of processing, the images are manipulated by electrical means by varying the electrical signal. The common example include is the television image.

Digital image processing has dominated over analog image processing with the passage of time due its wider range of applications.

3.5.8 DIGITAL IMAGE PROCESSING:

The digital image processing deals with developing a digital system that performs operations on an digital image.

3.5.9 IMAGE:

An image is nothing more than a two dimensional signal. It is defined by the mathematical function f(x,y) where x and y are the two co-ordinates horizontally and vertically.

The value of f(x,y) at any point is gives the pixel value at that point of an image. The above figure is an example of digital image that you are now viewing on your computer screen. But actually , this image is nothing but a two dimensional array of numbers ranging between 0 and 255.

3.5.10 RELATIONSHIP BETWEEN A DIGITAL IMAGE AND A SIGNAL

3.5.10.1 SIGNAL:

In physical world, any quantity measurable through time over space or any higher dimension can be taken as a signal. A signal is a mathematical function, and it conveys some information.

A signal can be one dimensional or two dimensional or higher dimensional signal. One dimensional signal is a signal that is measured over time. The common example is a voice signal.

The two dimensional signals are those that are measured over some other physical quantities. The example of two dimensional signal is a digital image. We will look in more detail in the next tutorial of how a one dimensional or two dimensional single and higher signals are formed and interpreted.

3.5.10.2 RELATIONSHIP:

Since anything that conveys information or broadcast a message in physical world between two observers is a signal. That includes speech or (human voice) or an image as a signal. Since when we speak, our voice is converted to a sound wave/signal and transformed with respect to the time to person we are speaking to. Not only this , but the way a digital camera works, as while acquiring an image from a digital camera involves transfer of a signal from one part of the system to the other.

3.5.10.3 HOW A DIGITAL IMAGE IS FORMED?

Since capturing an image from a camera is a physical process. The sunlight is used as a source of energy. A sensor array is used for the acquisition of the image. So when the sunlight falls upon the object, then the amount of light reflected by that object is sensed by the sensors, and a continuous voltage signal is generated by the amount of sensed data. In order to create a digital image, we need to convert this data into a digital form. This involves sampling and quantization. (They are discussed later on). The result of sampling and quantization results in an two dimensional array or matrix of numbers which are nothing but a digital image.

3.5.11OVERLAPPING FIELDS:

3.5.11.1 MACHINE/COMPUTER VISION:

Machine vision or computer vision deals with developing a system in which the input is an image and the output is some information. For example: Developing a system that scans human face and opens any kind of lock. This system would look something like this.

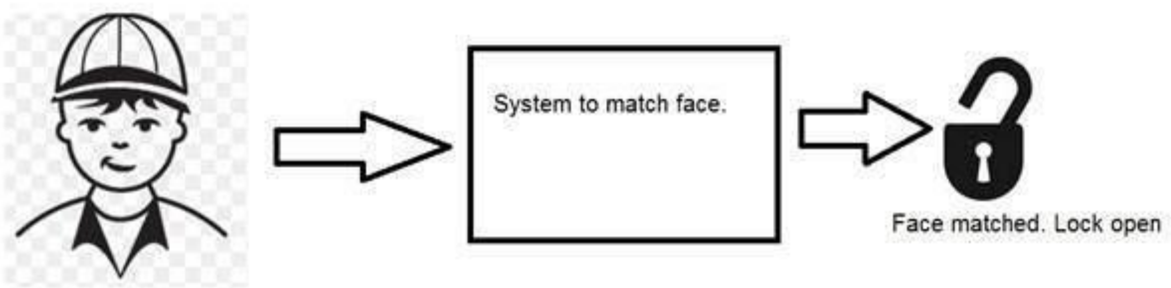


Fig 7 Machine /Computer Version

3.5.11.2 COMPUTER GRAPHICS:

Computer graphics deals with the formation of images from object models, rather then the image is captured by some device. For example: Object rendering. Generating an image from an object model. Such a system would look something like this.

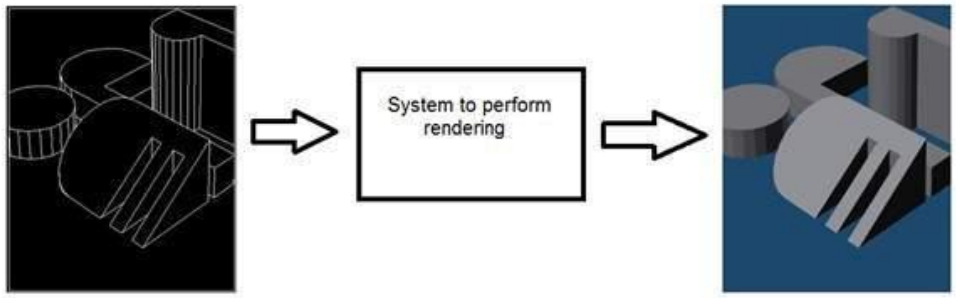


Fig 8. Computer Graphics

3.5.11.3 ARTIFICIAL INTELLIGENCE:

Artificial intelligence is more or less the study of putting human intelligence into machines. Artificial intelligence has many applications in image processing. For example: developing computer aided diagnosis systems that help doctors in interpreting images of X-ray , MRI e.t.c and then highlighting conspicuous section to be examined by the doctor.

3.5.12 SIGNAL PROCESSING:

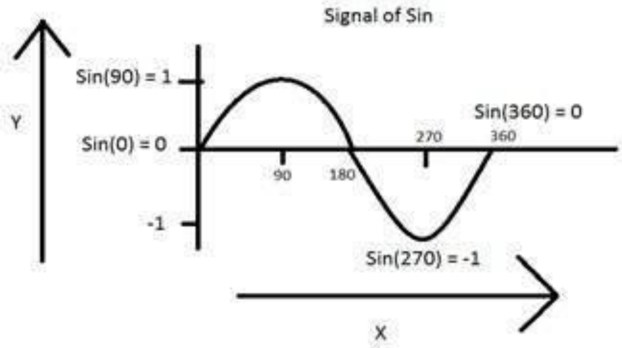
Signal processing is an umbrella and image processing lies under it. The amount of light reflected by an object in the physical world (3d world) is pass through the lens of the camera and it becomes a 2d signal and hence result in image formation. This image is then digitized using methods of signal processing and then this digital image is manipulated in digital image processing.

3.5.12 SIGNALS:

In electrical engineering, the fundamental quantity of representing some information is called a signal. It does not matter what the information is i-e: Analog or digital information. In mathematics, a signal is a function that conveys some information. In fact any quantity measurable through time over space or any higher dimension can be taken as a signal. A signal could be of any dimension and could be of any form.

3.5.12.1 ANALOG SIGNALS:

A signal could be an analog quantity that means it is defined with respect to the time. It is a continuous signal. These signals are defined over continuous independent variables. They are difficult to analyze, as they carry a huge number of values. They are very much accurate due to a large sample of values. In order to store these signals , you require an infinite memory because it can achieve infinite values on a real line. Analog signals are denoted by sin waves.



3.5.12.2 HUMAN VOICE:

Human voice is an example of analog signals. When you speak, the voice that is produced travel through air in the form of pressure waves and thus belongs to a mathematical function, having independent variables of space and time and a value corresponding to air pressure.

Another example is of sin wave which is shown in the figure below.

Y = sin(x) where x is independent

3.5.12.3 DIGITAL SIGNALS:

As compared to analog signals, digital signals are very easy to analyze. They are discontinuous signals. They are the appropriation of analog signals.

The word digital stands for discrete values and hence it means that they use specific values to represent any information. In digital signal, only two values are used to represent something i-e: 1 and 0 (binary values). Digital signals are less accurate then analog signals because they are the discrete samples of an analog signal taken over some period of time. However digital signals are not subject to noise. So they last long and are easy to interpret. Digital signals are denoted by square waves.

3.5.13 COMPUTER KEYBOARD:

Whenever a key is pressed from the keyboard, the appropriate electrical signal is sent to keyboard controller containing the ASCII value that particular key. For example the electrical signal that is generated when keyboard key a is pressed, carry information of digit 97 in the form of 0 and 1, which is the ASCII value of character a.

3.5.14 DIFFERENCES BETWEEN ANALOG AND DIGITAL SIGNALS:

Comparison element	Analog signal	Digital signal
Analysis	Difficult	Possible to analyze
Representation	Continuous	Discontinuous
Accuracy	More accurate	Less accurate
Storage	Infinite memory	Easily stored
Subject to Noise	Yes	No
Recording Technique	Original signal is preserved	Samples of the signal are taken and preserved
Examples	Human voice, Thermometer, Analog phones e.t.c	Computers, Digital Phones, Digital pens, e.t.c

TABEL 1.DIFFERENCES BETWEEN ANALOG AND DIGITAL SIGNAL

3.5.15 SYSTEMS:

A system is a defined by the type of input and output it deals with. Since we are dealing with signals, so in our case, our system would be a mathematical model, a piece of code/software, or a physical device, or a black box whose input is a signal and it performs some processing on that signal, and the output is a signal. The input is known as excitation and the output is known as response.

Fig 9. Analog Signal

In the above figure a system has been shown whose input and output both are signals but the input is an analog signal. And the output is an digital signal. It means our system is actually a conversion system that converts analog signals to digital signals.

3.5.16 CONVERSION OF ANALOG TO DIGITAL SIGNALS:

Since there are lot of concepts related to this analog to digital conversion and vice-versa. We will only discuss those which are related to digital image processing.There are two main concepts that are involved in the coversion.

- Sampling
- Quantization

3.5.16.1 SAMPLING:

Sampling as its name suggests can be defined as take samples. Take samples of a digital signal over x axis. Sampling is done on an independent variable. In case of this mathematical equation:

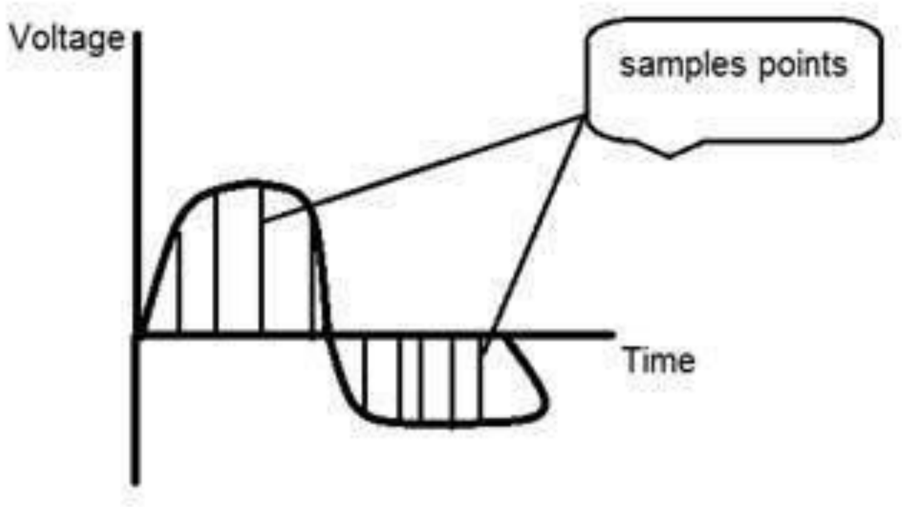


Fig 10. Sampling

Sampling is done on the x variable. We can also say that the conversion of x axis (infinite values) to digital is done under sampling.

Sampling is further divide into up sampling and down sampling. If the range of values on x-axis are less then we will increase the sample of values. This is known as up sampling and its vice versa is known as down sampling.

3.5.16.2 QUANTIZATION:

Quantization as its name suggest can be defined as dividing into quanta (partitions). Quantization is done on dependent variable. It is opposite to sampling. In case of this mathematical equation y = sin(x)

Quantization is done on the Y variable. It is done on the y axis. The conversion of y axis infinite values to 1, 0, -1 (or any other level) is known as Quantization.

These are the two basics steps that are involved while converting an analog signal to a digital signal. The quantization of a signal has been shown in the figure below.

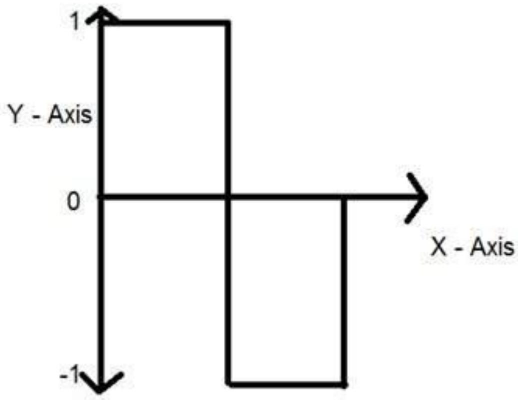


Fig 11. Quantization

3.5.16.3 APPLICATIONS OF DIGITAL IMAGE PROCESSING:

Some of the major fields in which digital image processing is widely used are mentioned below

- Image sharpening and restoration
- Medical field
- Remote sensing
- Transmission and encoding
- Machine/Robot vision
- Color processing
- Pattern recognition
- Video processing
- Microscopic Imaging
- Others

3.5.16.4 MEDICAL FIELD:

The common applications of DIP in the field of medical is

- Gamma ray imaging
- PET scan
- X Ray Imaging
- Medical CT
- UV imaging

3.5.17 UV IMAGING:

In the field of remote sensing , the area of the earth is scanned by a satellite or from a very high ground and then it is analyzed to obtain information about it. One particular application of digital image processing in the field of remote sensing is to detect infrastructure damages caused by an earthquake.

As it takes longer time to grasp damage, even if serious damages are focused on. Since the area effected by the earthquake is sometimes so wide , that it not possible to examine it with human eye in order to estimate damages. Even if it is , then it is very hectic and time consuming procedure. So a solution to this is found in digital image processing. An image of the effected area is captured from the above ground and then it is analyzed to detect the various types of damage done 78by the earthquake.

Fig 12. UV Image

The key steps include in the analysis are

- The extraction of edges
- Analysis and enhancement of various types of edges

3.5.18 TRANSMISSION AND ENCODING:

The very first image that has been transmitted over the wire was from London to New York via a submarine cable. The picture that was sent is shown below.

Fig 13. Transmission and Encoding

The picture that was sent took three hours to reach from one place to another. Now just imagine , that today we are able to see live video feed , or live cctv footage from one continent to another with just a delay of seconds. It means that a lot of work has been done in this field too. This field doesnot only focus on transmission , but also on encoding. Many different formats have been developed for high or low bandwith to encode photos and then stream it over the internet or e.t.c.

3.5.19 MACHINE/ROBOT VISION:

Apart form the many challenges that a robot face today , one of the biggest challenge still is to increase the vision of the robot. Make robot able to see things , identify them , identify the hurdles e.t.c. Much work has been contributed by this field and a complete other field of computer vision has been introduced to work on it.

3.5.20 Hurdle Detection:

Hurdle detection is one of the common task that has been done through image processing, by identifying different type of objects in the image and then calculating the distance between robot and hurdles.

Fig 14. Line follower robot

Most of the robots today work by following the line and thus are called line follower robots. This help a robot to move on its path and perform some tasks. This has also been achieved through image processing.

3.5.21 Computer Vision:

Computer vision is concerned with modeling and replicating human vision using computer software and hardware. Formally if we define computer vision then its definition would be that computer vision is a discipline that studies how to reconstruct, interrupt and understand a 3d scene from its 2d images in terms of the properties of the structure present in scene.

It needs knowledge from the following fields in order to understand and stimulate the operation of human vision system.

- Computer Science
- Electrical Engineering
- Mathematics
- Physiology

- Biology
- Cognitive Science

3.5.22 Computer Vision Hierarchy:

Computer vision is divided into three basic categories that are as following:Low-level vision: includes process image for feature extraction.Intermediate-level vision: includes object recognition and 3D scene InterpretationHigh-level vision: includes conceptual description of a scene like activity, intention and behavior.

3.5.22.1 Related Fields:

- Computer Vision overlaps significantly with the following fields:
- Image Processing: it focuses on image manipulation.
- Pattern Recognition: it studies various techniques to classify patterns.
- Photogrammetry: it is concerned with obtaining accurate measurements from images.

3.5.23 Computer Vision Vs Image Processing:

Image processing studies image to image transformation. The input and output of image processing are both images. Computer vision is the construction of explicit, meaningful descriptions of physical objects from their image. The output of computer vision is a description or an interpretation of structures in 3D scene.

3.5.23.1 Example Applications:

- Robotics
- Medicine
- Security
- Transportation
- Industrial Automation

3.5.23.2 Robotics Application:

- Localization-determine robot location automatically

- Navigation
- Obstacles avoidance
- Assembly (peg-in-hole, welding, painting)
- Manipulation (e.g. PUMA robot manipulator)
- Human Robot Interaction (HRI): Intelligent robotics to interact with and serve people.

3.5.23.3 Medicine Application:

- Classification and detection (e.g. lesion or cells classification and tumor detection)
- 2D/3D segmentation
- 3D human organ reconstruction (MRI or ultrasound)
- Vision-guided robotics surgery

3.5.23.4 Industrial Automation Application:

- Industrial inspection (defect detection)
- Assembly
- Barcode and package label reading
- Object sorting
- Document understanding (e.g. OCR)

3.5.23.5 Security Application:

- Biometrics (iris, finger print, face recognition)
- Surveillance-detecting certain suspicious activities or behaviors

3.5.23.6 Transportation Application:

- Autonomous vehicle
- Safety, e.g., driver vigilance monitoring

3.5.24 Computer Graphics:

Computer graphics are graphics created using computers and the representation of image data by a computer specifically with help from specialized graphic hardware and software. Formally we can say that Computer graphics is creation, manipulation and storage of geometric objects (modeling) and their images (Rendering).

The field of computer graphics developed with the emergence of computer graphics hardware. Today computer graphics is use in almost every field. Many powerful tools have been developed to visualize data. Computer graphics field become more popular when companies started using it in video games. Today it is a multibillion dollar industry and main driving force behind the computer graphics development. Some common applications areas are as following:

3.5.24.1 Computer Aided Design:

- Used in design of buildings, automobiles, aircraft and many other product
- Use to make virtual reality system.

3.5.24.2 Presentation Graphics:

- Commonly used to summarize financial, statistical data
- Use to generate slides

3.5.24.3 3d Animation:

- Used heavily in the movie industry by companies such as Pixar, DresmsWorks
- To add special effects in games and movies.

3.5.24.4 Education and training:

- Computer generated models of physical systems
- Medical Visualization

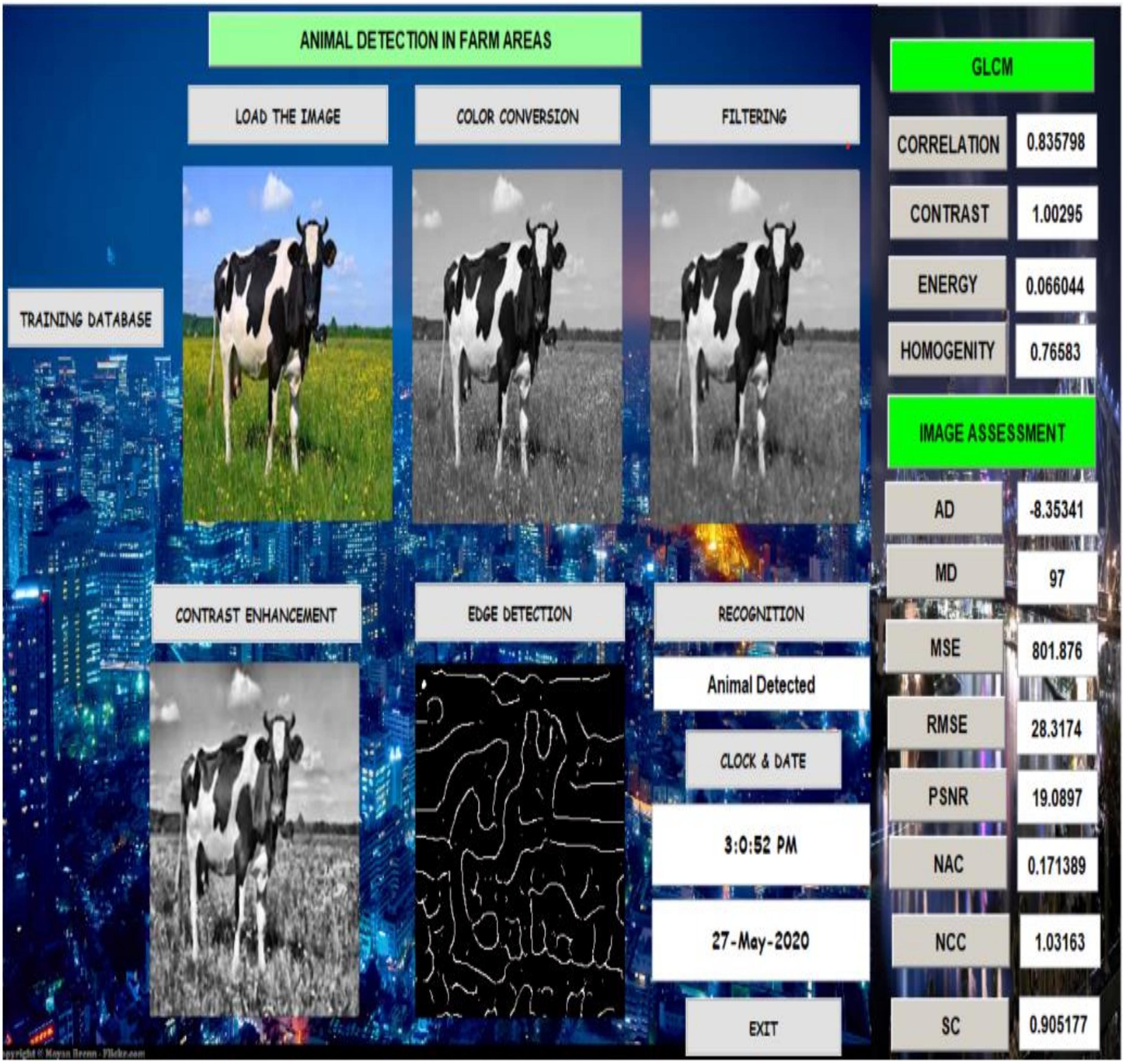
- 3D MRI
- Dental and bone scans
- Stimulators for training of pilots etc.

3.5.24.5 Graphical User Interfaces:

- It is used to make graphical user interfaces objects like buttons, icons and other components

Chapter 4

RESULTS



Chapter 5

CONCLUSIONS

The Software part of the IOT based farm protection consist of trained database. Firstly it differentiate between humans and animals.Later if it is found that it is animal the GUI part checks for the features such as color,conversion filtering,contrast enhancement,edge detection. Database is where the features are already trained.GUI values is compared with database and the result of animal entered is shown.

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APPENDIX A