

# **IMPLEMENTATION OF ADVANCED IMAGE STEGNOGRAPHY WITH HIGHER SECURITY USING LABVIEW AND ITS APPLICATION**

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award of the degree of

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**in**

**Microwave and Optical Communication**

Submitted by

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## CERTIFICATE

This is to certify that the thesis report entitled, " **Implementation Of Advanced Image Stegnography With Higher Security Using Labview And Its Application**" being submitted by **Amit Kumar** to the *Department of Electronics and Communication Engineering and Applied Physics, Delhi Technological University, Delhi* in partial fulfilment of the requirement for award of Master of Technology degree in **Microwave and Optical Communication** is a record of bona fide work carried out by him under the supervision and guidance of **Prof. P. R. Chadha**. The matter embodied in this report has not been submitted for the award of any other degree.

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# DECLARATION

I hereby declare that all the information in this document has been obtained and presented in accordance with academic rules and ethical conduct. This report is my own, unaided work. I have fully cited and referenced all material and results that are not original to this work. It is being submitted for the degree of Master of Technology in Engineering at the Delhi Technological University. It has not been submitted before for any degree or examination in any other university.

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# ABSTRACT

In secret communication steganography plays vital role for data security. Steganography is very advanced and highly secured data sharing technique. The goal is to encode the data image within the cover image such that the data image's existence is concealed. Cover media for image based steganography is image. Steganography deals with encoding data image information in a given image (called cover image) without making any visible changes to it. For advance security face recognition technique is used, so that only authorized person can access the data image. In this system dual security is provide first is encoding of data image in cover image and second is face recognition.

LabVIEW graphical programming environment is a tool for realizing the image acquisition and processing. This software has several advantages: simple implementation, modularity, flexibility, attractive user interface and possibility to develop very easy new features. Face recognition and machine vision applications in automatic inspection of various electronic modules can also be implemented using given algorithm.

To transmit and receive the encoded image USRP ( Universal Serial Radio Peripheral ) is used. USRP was developed to as a high speed, low cost and user friendly SDR platform. Apart from this in terms of transmission and reception different modulation scheme (QPSK, BPSK, M-ary PSK) is generated and transmit at different specific frequency in air. At receiver part transmitted signal is received and constellation diagram and eye diagram is plotted. At last BER (Bit Error Rate) is calculated and plotted in graph.

An application of face recognition is also implemented: Automatic Attendance System. It is an application of LabVIEW and camera interface which is used for taking attendance in classroom. The system use a camera which is connected to PC on USB interface and attached to each and every classroom for taking snap of students presented. LabVIEW graphical programming environment is a tool for realizing the image acquisition and processing. This software has several advantages: simple implementation, modularity, flexibility, attractive user interface and possibility to develop very easy new features. Face recognition and machine vision applications in automatic inspection of various electronic modules can also be implemented using given algorithm.

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# LIST OF ABBREVIATIONS

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LabVIEW- Laboratory Virtual Instrumentation Engineering Workbench

USRP- Universal Serial Radio Peripheral

BER- Bit Error Rate

ASK- Amplitude Shift Keying

PSK- Phase Shift Keying

QPSK- Quadrature Phase Shift Keying

BPSK- Binary Phase Shift Keying

SDR- Software Defined Radio

OS - Operation System

T&M- Test and Measurement

LED- Light Emitting Diode

LAN- Local Area Network

MIMO- Multiple-Input, Multiple-output

MPT- Multiple Packet Transmission

NI- National Instruments

DCR- Direct-conversion receiver

ADC- Analog-to-Digital convertor

DDC- Digital Down conversion

DUC- Digital up conversion

DAC- Digital to Analog conversion

API- Application programming interface

JPEG- Joint Photographic Experts Group

BMP- Bitmap Image

TX- Transmitter

RX- Receiver

RF- Radio Frequency

CR- Cognitive Radio

DSP- Digital Signal Processing

FPGA- Field Programmable Gate Array

RFID- Radio Frequency Identifications

MIMO- Multiple Input Multiple Output

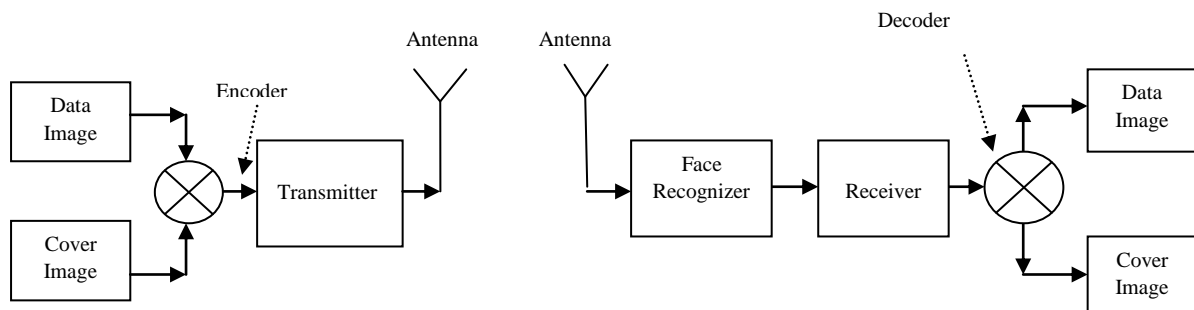
USB- Universal Serial Bus

# Chapter 1

## Introduction

### 1.1 Overview

From last few years cryptography has been used for data hiding and security. Cryptography was a method for securing the data for communication. Apart from cryptography there was many different methods that have been developed to encrypt and then decrypt data in order to maintain the message secret. But in case of cryptography the existence of message is not concealed, sometimes it is not enough to keep the contents of a message secret, but along with content of message existence of message should also hide. For that propose a new technique is immersed which is called as steganography [1]. Steganography is very advanced version of data security technique where the existence of message is also concealed along with content of message. Type of steganography is defined in terms of file format we are using. Here we are discussing about image steganography in which information is hidden in terms of image.



**Figure 1.1:** Overview of steganography system

In the fig. 1.1 overall system of communication system with steganography and face recognition is shown. First of all a data image and a cover image is taken. Then encoding of data image with cover image is done [2]. Encoding is basically mapping of data image with cover image that means mapping of pixel values of data image with pixel value of cover image. The location of that pixel values [3] is used as key for decoding the data image from cover image. After encoding a transmitter is needed for transmission of image in any channel. Here USRP (Universal Serial Radio Peripheral) is used for transmission and reception. An

antenna is connected with USRP which can transmit the signal in specific range of frequencies.

At receiver side first of all face of the person who is decoding is recognized that the person is authorized person or not. Once face is recognized then receiver receives the cover image. The RX pin of USRP is used as receiver because USRP is full duplex. Now decoder decodes that cover image using the key and obtain data image. So here dual security is provided first is face recognition and second is key provided.

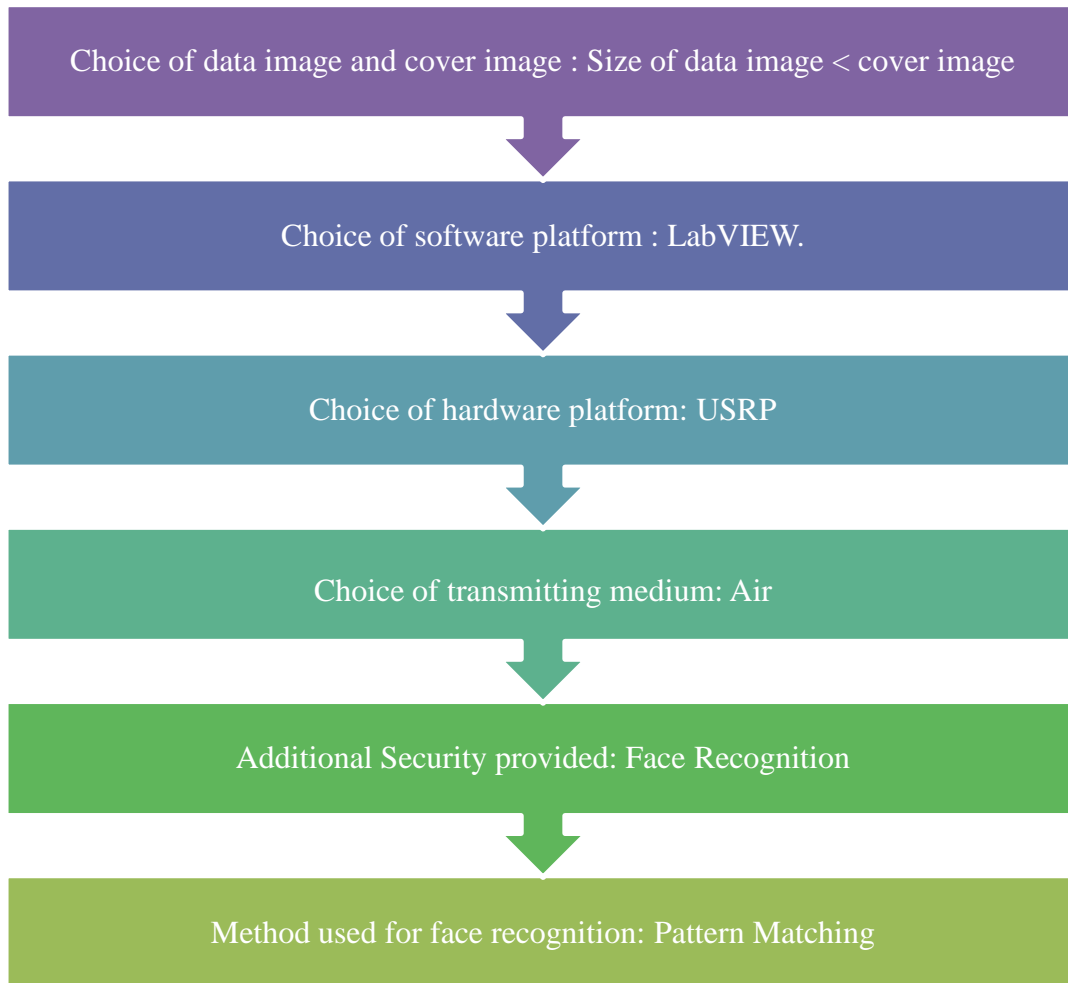
Another application which is implemented in this project is automatic attendance system.

All this environment is done on LabVIEW platform. LabVIEW is very user friendly platform for designing and testing purpose. LabVIEW and USRP can easily interface with each other to make any transmission and reception. Steganography is also designed in LabVIEW. Image processing toolkit is used for steganography.

## **1.2 Design Flow chart**

In the designing of image steganography system a software is needed which can process the image on its pixel values. LabVIEW is the software which is used for designing. Image processing toolkit should be added in LabVIEW for encoding and decoding of data image in cover image. Cover image chosen should be large in size than data image. For transmitter and receiver a hardware called USRP is required. USRP has transmitter and receiver section through which antenna is connected which can transmit and receive the signal. USRP is interfaced with LabVIEW so that the transmitted or received data can be process according to our requirement.

Flow chart of image steganography is shown below that describes the top to bottom process of design flow. The design starts from taking a cover image and a data image. Then encode that data image inside the cover image. Next step is to transmit that cover image. For transmission USRP is used. Now the next part is receiver. In receiver side first thing is face recognition. In designing template is saved in LabVIEW buffer which is face of authorized person and this is fully customizable. Pattern matching algorithm is used for face recognition. When authorized person come in front of camera then only next part will be executed. Next part is receiver and decoder. USRP acts as receiver and receive the transmitted cover image. After receiving cover image decoder extract data image by using key provided.



**Figure 1.2:** Flow chart of designing process for image steganography

### 1.3 Motivation and Problem Statement

Now a day's data security is very important in communication system. After reading many articles regarding data hack and data hiding problems. It is thought that messages can be secure to transmit and it can be ensured that only authorized persons can be extract messages by using a technique called steganography [5]. In this project it is tried to give maximum possible security for image transmission. So that we can easily send any secret message using this algorithm.

Problem Statement is to hide the data image into cover image [4] and most important thing is the existence of data image should not be visible in cover image and to provide advance security face recognition technique is used. Encoded cover image can be transmitted at any frequency in the range provided.



## 1.4 Objective/Scope of present work

The main objective of the research presented in this project is to design a communication system to secure data transmission and encode data image in cover image[6]. The goal of project is to understand the concept of data security and image transmission with different modulation schemes.

In communication system data security is very important part. In this project we are going to understand about image processing on pixel level. We access the image in terms of pixel values and map it with pixel values of another image. Different image processing functions explored in this project. Apart from post processing real time processing is also done in this project in case of face recognition. In terms of image transmission and reception all the functions of USRP is explored. Data communication function is used in transmitting signals with different modulation schemes. Finally a system is made have various functions like hiding data in term of image, sending that image to user and transmit and receive different modulation schemes like QPSK, BPSK etc.

## 1.5 Thesis Structure

The thesis report is divided into six chapters, each having ample information for comprehending the concept of this project.

Chapter 1 *introduces the background history of wireless technology, image processing and objective of research of image steganography.*

Chapter 2 *discussed the brief description of software and hardware used in the project. Along with description different applications are also discussed.*

Chapter 3 *provides details about steganography. Different types of steganography and its applications are also discussed. At last image steganography is discussed in brief.*

Chapter 4 *presents about face recognition and its applications. Then the process of face recognition and method used in this project for face recognition.*

Chapter 5 *discusses about communication system in this project. It is discussed that in steganography system how can we transmit and receive encoded image.*

Chapter 6 *discusses the design and simulation of whole project. All the parts of project i.e. encoder, transmitter, face recognizer, receiver and decoder are discussed along with design procedure of each block.*

The Final chapter of the thesis (Chapter 7) presents the conclusions and future aspects of this project. The significance and contribution of this work is summarized.

# Chapter 2

## SOFTWARE AND HARDWARE USED

### 2.1 LabVIEW

A platform is needed to design image steganography [1] which contains image processing functions as well as to develop program for wireless transmitter and receiver which require communication functions. A very user friendly development environment is available from National Instruments which is called LabVIEW ( Laboratory Virtual Instrumentation Engineering Workbench) [9]. Firstly this software released for the Apple Macintosh in 1986. Mostly it is used for industrial automation, instrument control, designing, testing and data acquisition on various platforms like Microsoft Windows, Linux, UNIX and Mac Operating system. Unlike text based programming graphical programming is used in LabVIEW which is in short called G- programming[10]. The flow of programming language used in LabVIEW is dataflow language not sequential language. The structure of graphical blocks determine the execution and result. The graphical nature of LabVIEW make it user friendly and ideal for data acquisition, instrument control, data analysis, automation and test & measurement (T&M). These features of LabVIEW is responsible for significant productivity improvements over conventional programming language.

Thus, LabVIEW is a tool for designing systems that provides scientists and engineers with different toolkits required to create and design measurement and control systems with the integration of different hardwares [9]. LabVIEW inspires us in three ways first is solve problems, second is accelerates your productivity, and third is gives you the confidence to innovate.



Figure 2.1: Introduction to LabVIEW

## 2.1.1 Overview of Programming Technique in LabVIEW

Dataflow programming is used in LabVIEW[8]. That means the execution of program is determined by the flow of graphical block diagram structure. The programmer connects the nodes of different functions by drawing wires. Whenever multiple functions get all required input values, LabVIEW G programming capable of parallel execution. Build-in scheduler is available in LabVIEW which automatically exploited multi-processing and multi-threading hardware. The execution sequence of program is fully controlled by programmer. Apart from that LabVIEW does not require to define the variables, the type of wire is already defined by data-supplying node [6]. Polymorphism is also supported by LabVIEW that means wires automatically adjust to various types of data.

LabVIEW converts programmer logic into the development cycle. There are three main components: Front panel, Block Diagram and the Connector panes. Front panel is used for giving a interface of program and user. It has controls and indicators which allows the user to input data into program or extract the output data from program [12]. Front panel is accessible by user. Block diagram consists of all function. All the programming is done in block diagram. Once input and output is placed in front panel the terminal for same will be shown in block diagram. By using wires and functions any logic can be programmed. Last one is connector pane which is responsible of wiring between two functions. The instruments which is made in LabVIEW software is called Virtual Instruments because before embedded it into real time hardware it can be tested in system itself by giving appropriate inputs and outputs. The programming in this is very simple. By using drag and drop the function virtually this software allows non-programmers to build the programs. Examples and proper documentation makes LabVIEW programming environment simpler for beginners. Hardware integration is very easy in LabVIEW. So real time process can easily implement in this software.



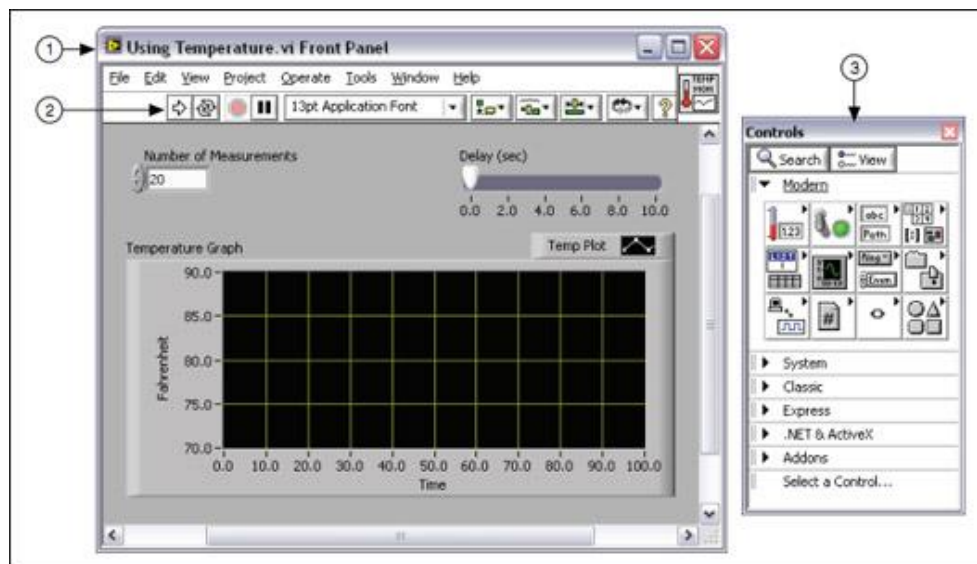
**Figure 2.2:** Graphical System Design

## 2.1.2 Virtual Instrumentation

LabVIEW is an environment where engineers can implement their logic and make a design. Before implementing on real hardware designer has to test it. LabVIEW is a platform where they can design it as well as test it in the system itself. No need to import the program on real hardware only for testing purpose. LabVIEW have nearly all the instruments available for testing or designer can also design their own instruments according to requirement inside LabVIEW itself. This instruments is called Virtual Instruments(VI) [12]. There are three main components of VI are: Front panel, Block Diagram and the Connector panes. Front panel is used for giving a interface of program and user [7]. It has controls and indicators which allows the user to input data into program or extract the output data from program. Front panel is accessible by user. Block diagram consists of all function. All the programming is done in block diagram. Once input and output is placed in front panel the terminal for same will be shown in block diagram. By using wires and functions any logic can be programmed. Last one is connector pane which is responsible of wiring between two functions.

### 2.1.2.1 Front Panel

The front panel window of the VI appears, when we open the new or existing file. The front panel window is the user interface for the VI. Fig 2.3 shows an example of a front panel window.



1. Front Panel

2. Toolbars

3. Control palette

**Figure 2.3:** Front Panel

### 2.1.2.2 Control Palette

Control Palette is group of controls and indicators that can be used to design and decorate the front panel. Control panel can be accessed by right clicking anywhere on the front panel or by selecting View then select Controls Palette [9]. All the controls and indicators are racked into different categories and according to our needs we can select any of them and place it only on front panel. In Fig 2.4 Controls palette is shown with all the categories and expanded category is Modern.

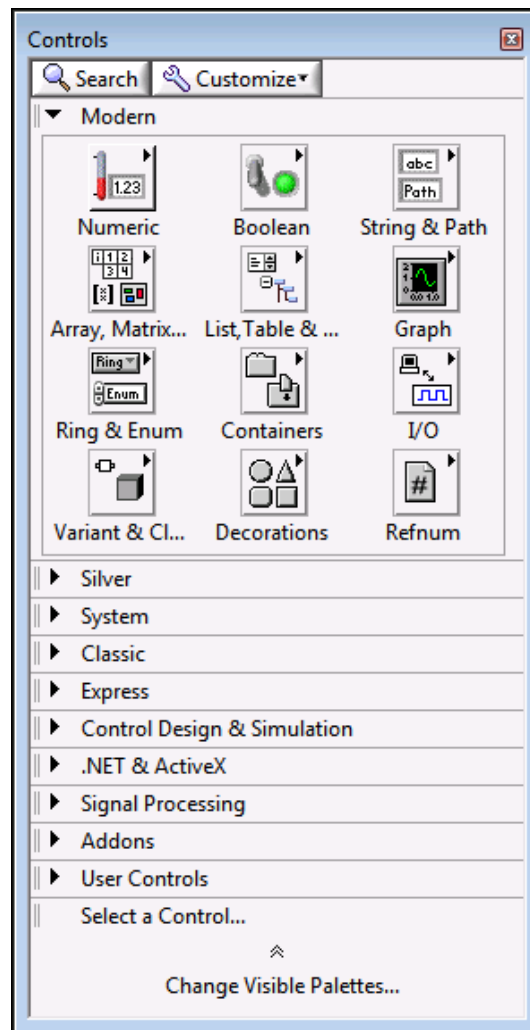


Figure 2.4: Control Palette

### 2.1.2.3 Controls and Indicators

These are used to indicate input and output. Front panel is basically user interface so here user have to pass inputs and receive outputs. User interface i.e. front panel is created by

placing controls and indicators from control palette on the front panel of a VI. When we run the VI we can give the inputs or modify the inputs by using controls and after executing we can see the results in indicators. Controls used for define the inputs, and indicators used to display the outputs.

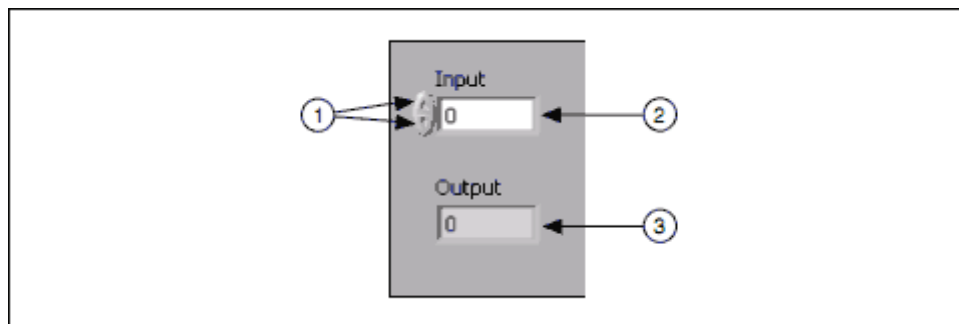
We have different kinds of inputs and outputs like Numerical type, Boolean type or String type. Controls are like numeric inputs, push buttons, sliders, knobs, strings and dials. Real time inputs can be also assessed by using input devices with instruments and supply data to block diagram of the VI. Charts, LEDs, graphs, string and charts are typically indicators. Simulated output will be displayed in indicator and output devices.

Here the Number of Measurements and Delay (sec) is controls that is quantifiable by users. The output value can be seen by Temperature Graph Indicator. Generated output of any VI is depend upon the code designed on block diagram.

Different data type is there like numeric, Boolean, and string has different control or indicator. Example is numeric control is slider.

### 2.1.2.4 Numeric Controls and Indicators

In many applications we need to use numeric data type in our design. To represent this numeric controls and indicators is used. There are various types of numeric data type like integer or real. In fig 2.5 common type of numeric control and indicator is shown.

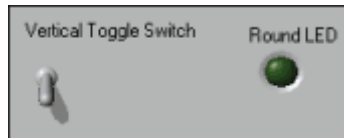


1. Increment/Decrement Button,      2. Numeric Control,      3 Numeric Indicator

**Figure 2.5:** Numeric Controls and Indicators

### 2.1.2.5 Boolean Controls and Indicators

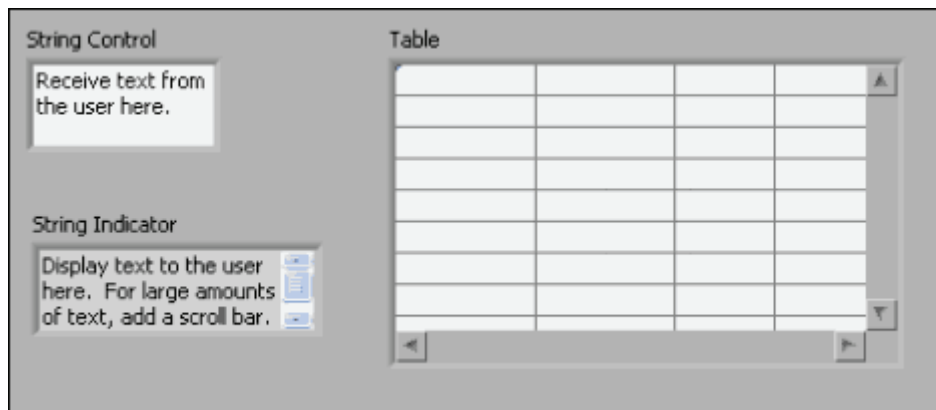
Sometimes we need inputs and outputs in term of yes/no or true/false. Boolean data type is used for the same. Examples of Boolean controls and indicators are push buttons and LEDs. In fig 2.6 the vertical toggle switch and the round LED are shown.



**Figure 2.6:** Boolean Controls and Indicators

### 2.1.2.6 Strings Controls and Indicators

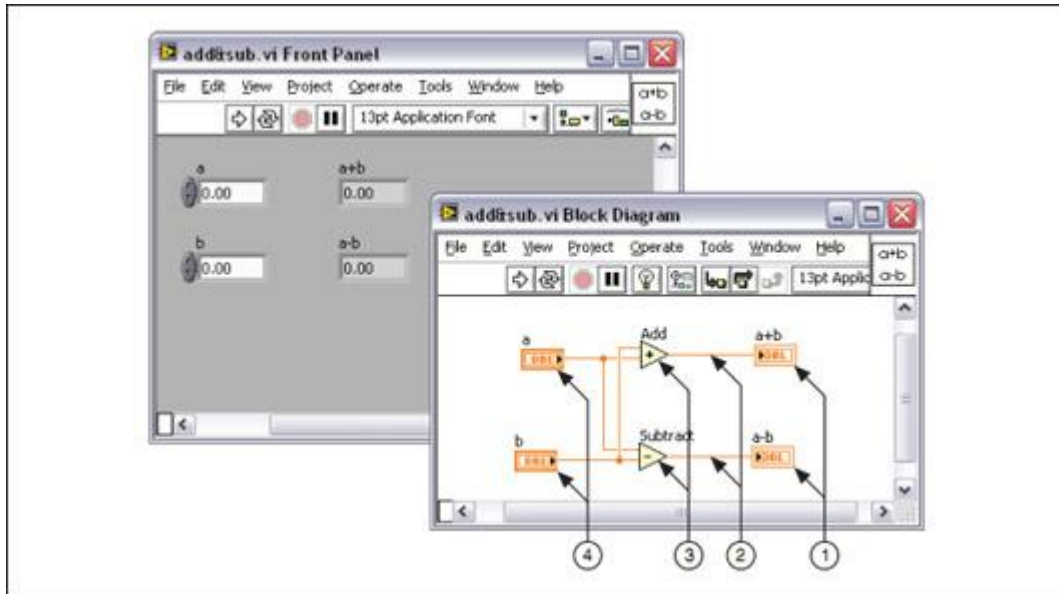
Another data type is string data type. It is nothing but a sequence of ASCII characters. Sometimes we need to enter password or store name there we use string data type. Tables and text entry boxes are example of string control and indicator as shown in fig 2.7.



**Figure 2.7:** String Controls and Indicators

### 2.1.2.7 Block Diagram

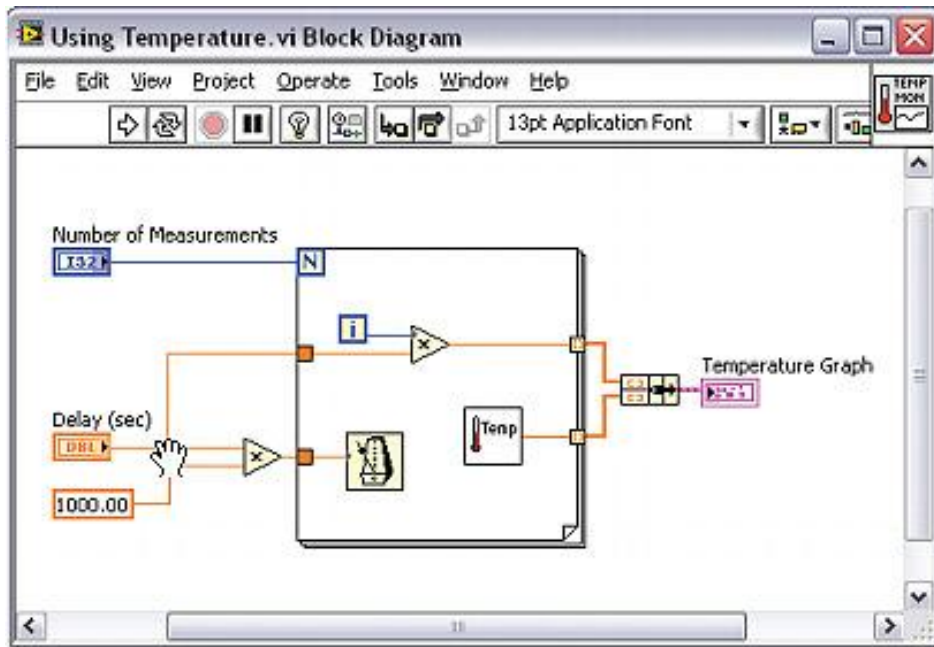
All the programming tools are available in block diagram for designing purpose. Wires, subVIs, functions, structures, constants and terminals are available in block diagram. Fig 2.8 shows an example of block diagram.



- 1. Indicator Terminal
- 2. Wire
- 3. Node
- 4. Control Terminal

**Figure 2.8:** Block Diagram and Corresponding Front Panel

After front panel window is created, we insert code using graphical demonstration of functions to control the front panel objects. The block diagram have this graphical source code as shown in fig 2.9.



**Figure 2.9:** Block Diagram



### 2.1.2.8 Functions

For designing any instrument the basic requirement is function. Function is a code which takes input and according to internal code. Example of some functions are shown in fig 2.8 which are add and subtract. Front panel or block diagram is not there in functions but they have connector panes only. Its icon has pale yellow background.

### 2.1.2.9 Functions Palette

All the functions are available in a palette which is called Function Palette. It contains functions, constants and VIs. We use these to design block diagram. To access the functions palette from the block diagram by right click on block diagram or by selecting View>> Functions Palette. In fig. 2.10 Functions Palette with all the categories is shown.

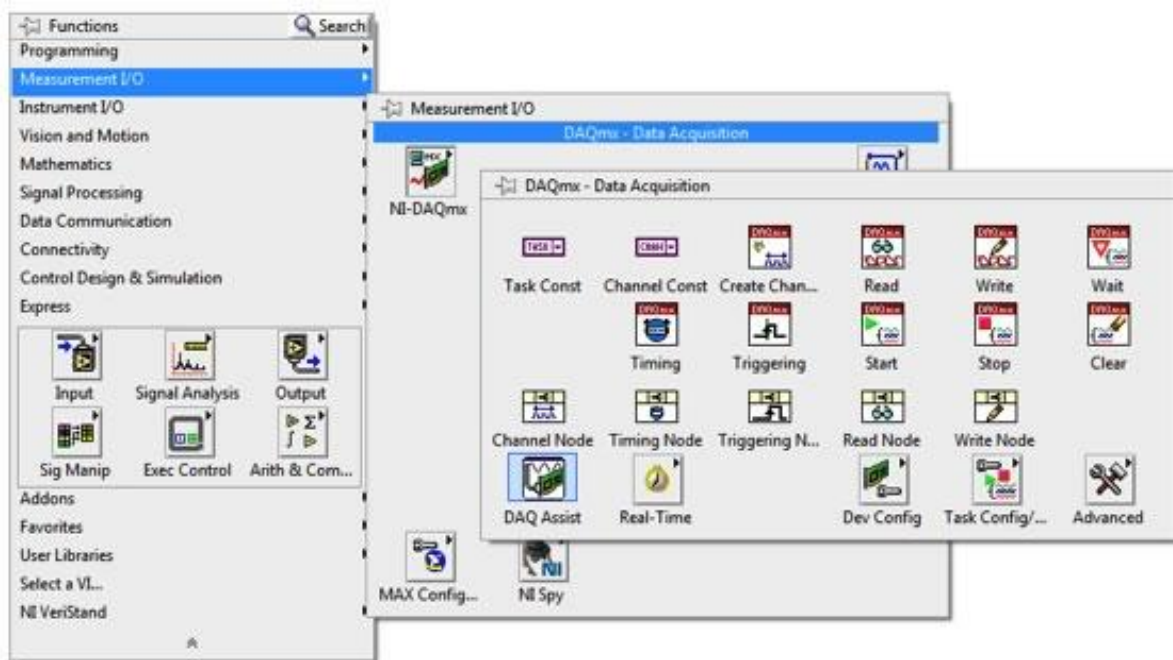


Figure 2.10: Functions Palette

## 2.2 USRP (Universal Serial Radio Peripheral)

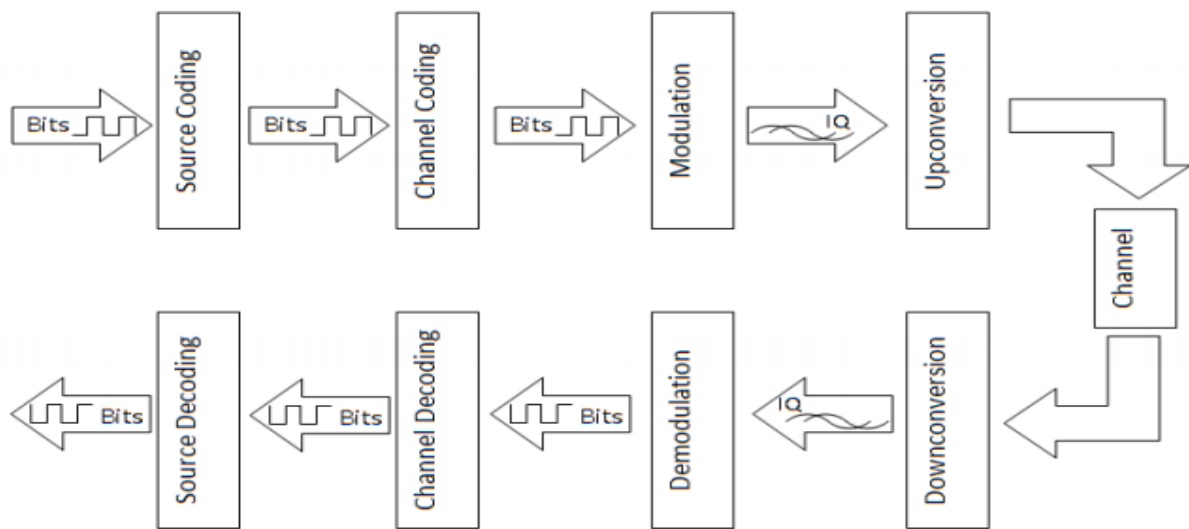
From the last few years wireless communication system has exponential growth in various fields like image communication, voice communication, text communication and radios. In conventional approach, hardware plays vital role in wireless communication but hardware approach has lots of limitations. So instead of using only hardware, here software is also used in conjugation for wireless communication. By using software in place of hardware our communication systems become more configurable. Traditional communication systems

approach has very less adaptation of new technologies. Hardware is designed for very specific band of frequency. So, whenever, it is required to change the frequency, it has to change hardware but in the case of software defined radio, it need to change the parameters only and automatically hardware can change the respective parameters too. Using LabVIEW as software to make radio function with the hardware USRP by the USRP, signal can be transmitted and received and output could be seen on the PC. So , software defined radio technology [13-14] carries the flexibility, cost effective and control to drive wireless communication by service suppliers and product creators through the users end [15]. USRP can be used as software defined radio (SDR), cognitive radio (CR), digital signal processing (DSP), multi-rate DSP, communication systems, FPGA system design and implementation and a wide verity of other areas [16]. Transceiver of string type data between two USRPs using GNU technique is implemented [17]. In a multiple input multiple output (MIMO) system with different h-users that a multiple transmit antennas at transmitter h and multiple receive antennas at receiver k, gives the real-time wireless interface implementation of 2\*2 MIMO using SDR [18]. In this research, we transmit different modulation schemes signal (such as QPSK, 8-PSK, 16-PSK, pi/4-PSK, and OQPSK) from TX1 i.e. from USRP1 and received the same to RX1 at USRP2 and their constellation diagram, eye diagram and bit error plots are shown by the LabVIEW. Comparison of BER among different modulation schemes is shown in this project. Each modulation schemes have certain limitations. So according to application specific modulation scheme can be chosen. In the Software defined system, there is option of changing the types of modulation format from the software called LabVIEW. So, it is general purpose platform for basic communication system. Universal software defined radio is used as a hardware for software defined system. It is the combination of hardware and driver software, which is capable to transmit and receive signals in wide range of frequency, 0 – 5 GHz. However, frequency range depends on the USRP used.

### **2.2.1 Introduction to Wireless networks**

In recent years, wireless networks have been wide range of applications in recent years, since as compared to conventional wired networks, the installation of wireless networks are easier to install and cheap in installation. Wireless networks have many advantages over wired networks. Due to great interest in research area and practical interest many improvements have been achieved in the field of wireless networks. Speed of communication is increased

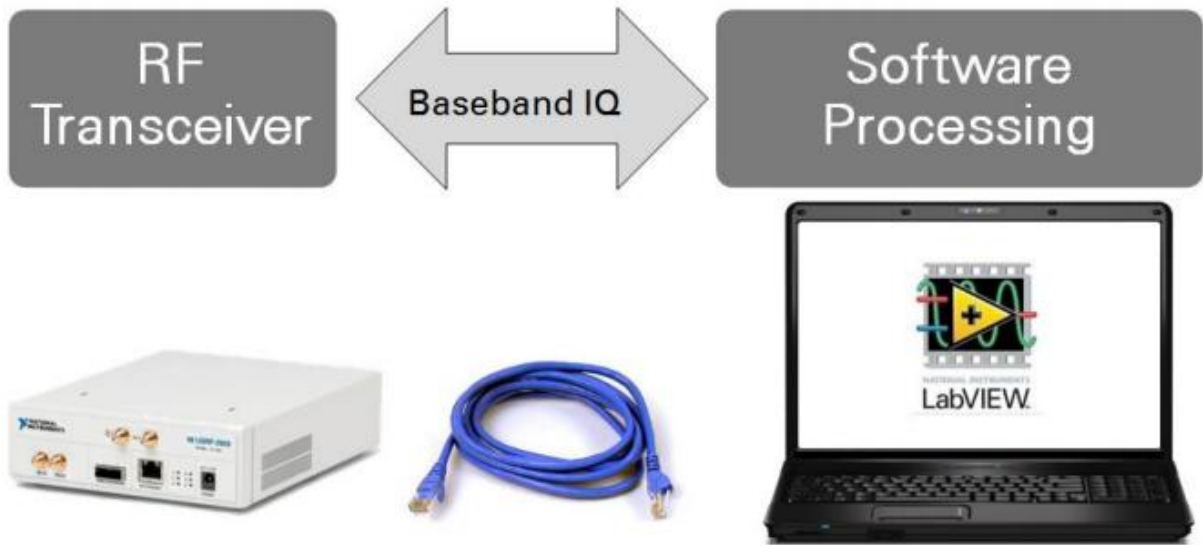
by adopting newer technology and improve the technique of communication. For example the data rate in 802.11b wireless LAN was 1Mbps which has been increased to 54 Mbps in 802.11a. In point to point transmission this new technique improve performance of wireless networks. In this project, we study about Multiple-Input, Multiple-output (MIMO) technique called Multiple Packet Transmission (MPT). In this one sender can send more than one packet to different users simultaneously. Fig 2.11 shows the complete process of digital communication system.



**Figure 2.11:** Digital Communication System Block Diagram

## 2.2.2 Overview of USRP

I use USRP (Universal Serial Radio Peripheral) for transmitting and sending any data. USRP is a hardware with open software which is user friendly and very powerful for wireless prototyping [16]. It has online community on NI website for improvements. USRP family has wide range of devices with different frequency ranges. USRP can be connected to host computer via Gigabit Ethernet or USB 2.0. USRP can be used to design GNU radios. The basic use of USRP is transmitting and receiving any signal at a specified frequency.



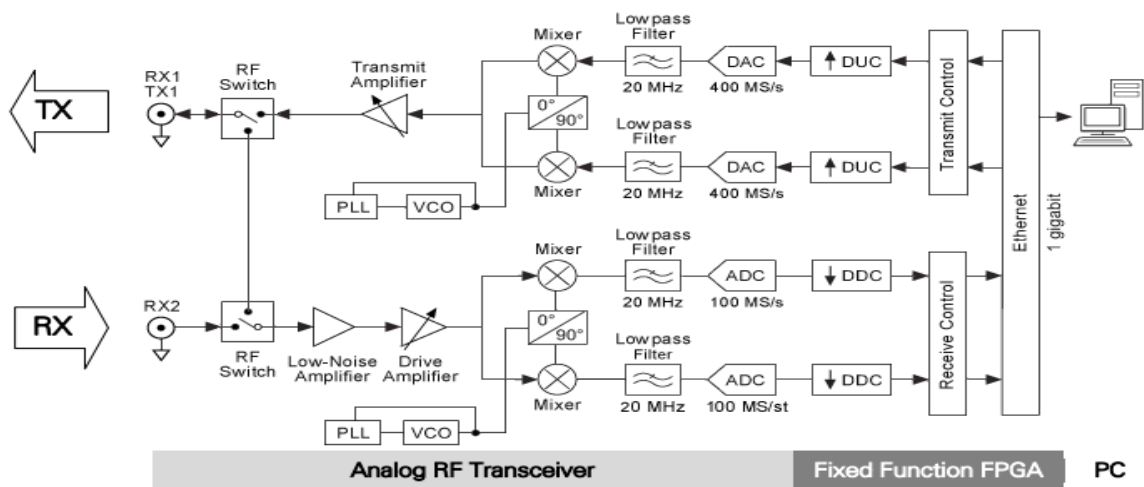
**Figure 2.12:** Overview of setup built around an NI USRP

### 2.2.3 USRP Hardware

Universal software defined radio (USRP), a hardware platform for software defined radio (SDR) [19], consist of USB controller, ADC/DAC and FPGA as given in fig. 2.13 [20]. USRP motherboard is placed in between RF front-end and the host PC. The USRP board is connected through Ethernet cable to the hosting PCs [21]. In the experiment, we used two host PC and two USRPs, from USRP1 signal is transmitted through antenna TX1 and received at the receiving antenna RX1 of USRP2 and the these parameters are used: IQ sampling 2M, carrier frequency 915 M, Gain 12dB, transmitter/receiver filter is root raised cosine, host PC IP address is 192.168.10.3 and USRP IP address is 192.168.10.2.

We can design Software-defined radio (SDR) by connecting NI USRP to a host PC. From fig 2.13 we can observe that at input side or incoming side standard SMA connector is there to direct-conversion receiver (DCR) to baseband I/Q components. I/Q components are sampled be a 2-channel, which is at 100MS/s and 14 bit analog-to-digital convertor (ADC). After that digital down conversion (DDC) process is done by digitized I/Q data will follow the path which is parallel through that process. Which results as mixes, filters and decimates the sampled 100MS/s signal to a user specified rate. The samples which is down converted, these signals when represented as a 32-bit ( 16 bits for I and 16 bits for Q) numbers are just pass to the host PC at up to 20 MS/s over a standard Gigabit Ethernet connections. In case of transmission, first of all the samples of baseband I/Q signal are synthesized by the host PC the given to USRP at sampling rate 20 MS/s over standard Gigabit Ethernet connection which

is represented with 32-bits (16-bits for I and 16 bits for Q components) signal. Now the interpolation is done to incoming signal to 400 MS/s by USRP using a DUC (Digital up conversion) process. This converts the incoming signal to analog signal by using a dual signal, 16-bit DAC (digital to analog convertor). The output signal of DAC is mixed up to the carrier frequency which is specified. 16-bits total are used in which 8 bit mode to represent I/Q data of a down converted sample or by using Gigabit Ethernet connection between the host PC and USRP can be enable a transfer rate of around 40 MS/s. Fig 2.13 shows the block diagram of USRP.

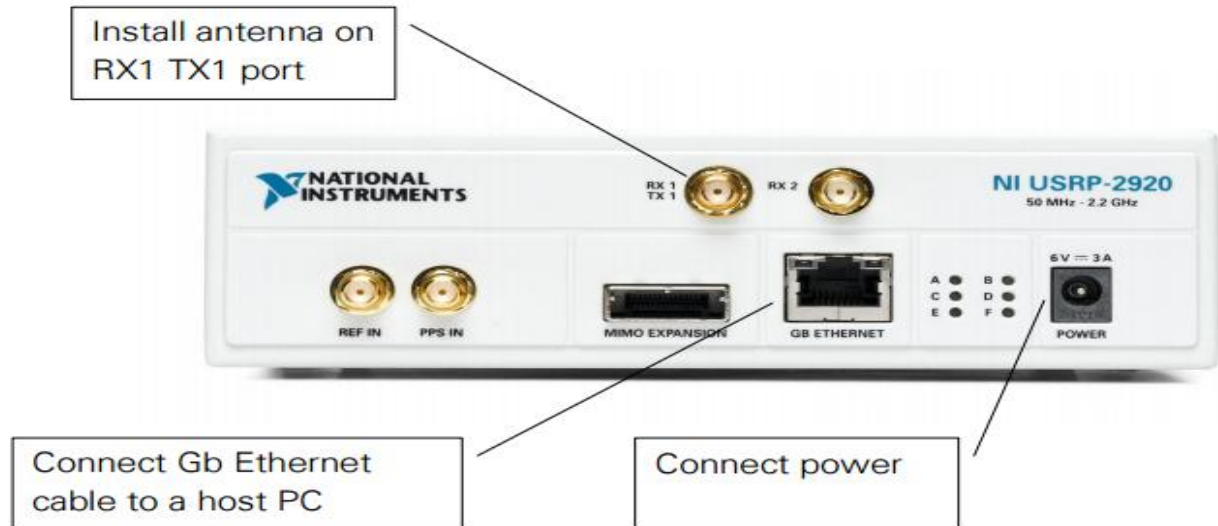


**Figure 2.13:** USRP Block Diagram

DAC is used because the signal from PC is in digital form and we have to transmit the data in analog form.

In other hand in lower part of block diagram which shows receiver part to USRP is having analog to digital convertor (ADC). Receiver takes the data from real world in analog form and convert it into digital form and send it to PC. So that we can process this data in PC.

Front view of USRP is shown in fig. 2.14



**Figure 2.14:** USRP front view

## 2.2.4 Software Defined Radio (SDR)

SDR system is a transmission reception system or we can say that radio communication system in which some hardware components are implemented in software [15]. Filters, amplifiers, modulator and demodulator are some hardware that can be implemented in software. Due to implementation of these hardware in software the system will be very flexible, we can adjust the parameters easily using the software without making significant hardware change. There are software available to implement these hardware in computer since today computers contain very fast processors and high-speed busses for interface any hardware. So we can implement software defined radio quickly in our PCs. Different drivers are available to interact the external devices. By abstracting low-level hardware commands and register-level programming we can simply communicate with devices. Driver software is provided by vendors and it exposes an API (Application programming interface) that is used to build application software within a programming environment. NI- USRP is driver for USRP.

Apart from driver software we also require application software which provide the interaction between the computer and user for programming for different applications like acquiring, analyzing, processing and presenting the data which is measured. In application software we can have predefined function or we can build the function by available programming environment.

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## STEGANOGRAPHY

### 3.1 Overview of steganography

In secret communication steganography plays vital role for data security [1]. Steganography is very advanced and highly secured data sharing technique. The goal is to encode the data image within the cover image such that the data image's existence is concealed. Cover media for image based steganography is image. Steganography deals with encoding data image information in a given image (called cover image) without making any visible changes to it. For advance security face recognition technique is used, so that only authorized person can access the data image.

From last few years cryptography has been used for data hiding and security. Cryptography was a method for securing the data for communication. In case of cryptography the existence of message is not concealed, sometimes it is not enough to keep the contents of a message secret, but along with content of message existence of message should also hide. For that propose a new technique is immersed which is called as steganography. Steganography is very advanced version of data security technique where the existence of message is also concealed along with content of message. Type of steganography is defined in terms of file format we are using. Here we are discussing about image steganography in which information is hidden in terms of image.

There are several properties which decides the performance of steganographic system. Undetectability is one of the properties which shows how complex it is to confirm the existence of message data. It is most important property to measure which is also called imperceptibility. Other property to measure is the steganographic capacity, which shows the maximum information that can safely be embedded in cover media without having detectable objects and robustness. It refers to how well the extraction of hidden data resist from steganographic system.

We can use nearly all types of file formats with higher degree of redundancy can be used for steganography. The parts which is capable of change without any possibility to detect the alteration is called redundant parts. The best file format which satisfy the requirement is image and audio file format. Being precise the most used carrier file format is digital images. For different applications different steganographic techniques are used depending upon taxonomy of algorithms.



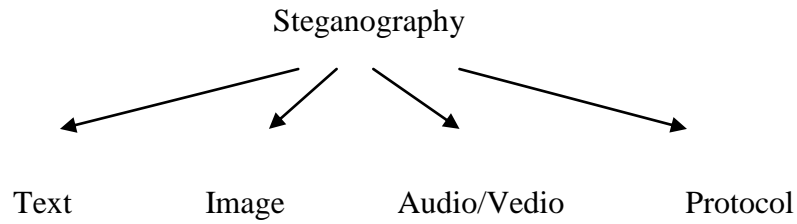
**Figure 3.1:** Encoded image

### **3.2 Types of steganography**

We can use nearly all types of file formats with higher degree of redundancy can be used for steganography. The best file format which satisfy the requirement is image and audio file format. Being precise the most used carrier file format is digital images. For different applications different steganographic techniques are used depending upon taxonomy of algorithms.

Four main categories of file formats that are shown in fig. 3.2 can be used for Steganography.





**Figure 3.2:** Categories of Steganography

### 3.3 Image Steganography

Generally we use images as cover object in case of steganography. Different formats of digital images are available in the domain of digital image. These file formats are for specific applications. Different steganographic algorithms exist for different file formats.

#### 3.3.1 Image Definition

Digital image is basically the combination of different light intensities in different parts of an image. The smallest points form a grid to whole image, the individual small points are called as pixels. The combinations of pixels form a whole image. The image in a PC consist of rectangular combination of pixels which are represented as bits and its color. The combination of these pixels are horizontally row by row. Bit depth is known as the number of bits in a color scheme and the number of bits used to represent each pixel. 8 bit is smallest bit depth to describe the color image pixel so the smallest bit depth is 8 in current color scheme. Another type of image is grayscale image. These images use 8 bits to represent each pixel and then able to display  $2^{16} = 256$  different shades. RGB color model is the model to represent digital color images which is typically stored in 24-bit files. These are known as true color.

#### 3.3.2 Image Compression

After encode the image we need to transmit it in air and if we work with larger images with greater bit depth then images become too large to transmit through USRP. We need to reduce the size of image in order to transmit it efficiently [6]. Various techniques are available to reduce the size of an image. Mathematical formulas are available to image file size reduction for different techniques. These mathematical formulas are used to analyze and condense the image data which results in smaller size image. The process of reducing the size of image is called as compression of image. Lossy and lossless are the two types of compression of

image. The procedures to implement are different. Both methods save storage space to save the image.

First type which is lossy compression discards the excess data of image from the original image and creates smaller files. The details removed by this technique these details are too small for human eye to differentiate so that it is close approximations of original image but not exact duplicate. JPEG (Joint Photographic Experts Group) is an example.

Other type is lossless compression which never delete any information from the original image but it represent data in mathematical formulas. The integrity of original image is maintained and the bit-by-bit identical decomposed image output is obtained. GIF (Graphical Interchange Format) and BMP (Bitmap file ) are examples of lossless compression.

In steganographic algorithm the compression of image plays vital role. In case of lossy compression techniques possibility of message part lost increases but image size become small. Lossless compression of image keeps the original data no data loss is there but image does not compress to such a small file.

# Chapter 4

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## FACE RECOGNITION

### 4.1 Introduction

In this project we provide additional security by face recognition in decoder part. So that only authorized person is able to decode the message image or data image [4]. In recent years, image processing applications becomes very attractive and its research has rapidly expanded in various fields like engineering and neuroscience. Because it has many applications in computer vision and control system. The first step of face recognition is automatic face detection. Face detection is not very easy task because it has lots of variations in appearance like occlusion, pose variation (front, non-front), image orientation, facial expression and illuminating conditions [7].

In Our Project we use Pattern Matching algorithm for Face Detection.

In case of quickly locate the pattern known reference or fiducially patterns in an image pattern matching algorithm is used. There are many applications of pattern matching. The information that it can provide are about presence or absence of object, number and location of object within an image [5].

### 4.2 Applications of pattern matching

The three general applications where pattern matching is used [10]:

\* **Alignment** -- It measure the orientation and position of the object whose template is pre stored by locating frames and features. The features which is pre stored as template is used as reference on the object.

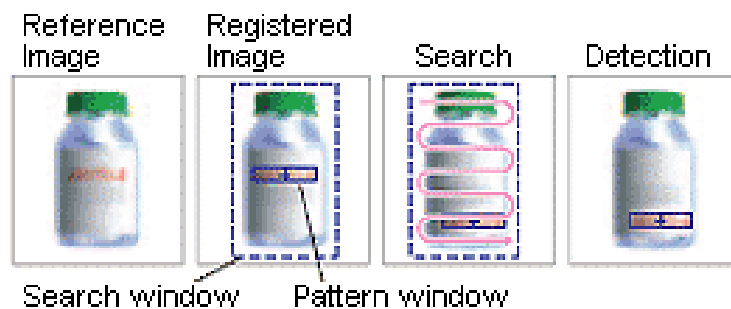
\* **Gauging** -- It measure the dimensions of object. Lengths, diameters and angles are some example of critical dimensions. Sometimes measurement fall outside of pre set tolerance level at that time the outside component is rejected.

\* **Inspection** -- It detect simple flaws in pattern matching such as missing parts or unreadable printing

## 4.3 Processes of Pattern Matching

### 4.3.1 Recognizes the pattern of an image

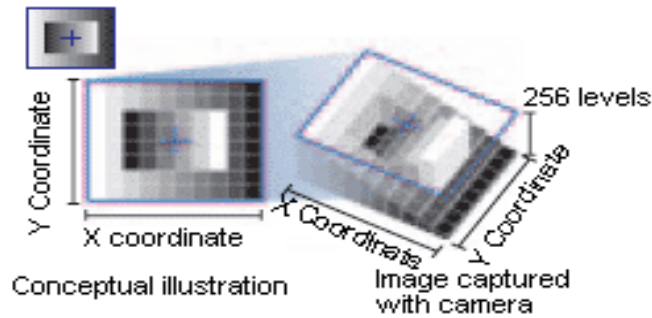
The template or reference of image is registered and stored in a buffer [9]. Then at the time of execution it scans the whole image from up to down and right to left for the specified region which is similar to pre stored template. The search is done from the upper left-hand corner to lower right-hand corner to detect the position which is best matches the registered image. Fig 4.1 shows how to recognize the pattern of an image.



**Figure 4.1:** Recognizing the pattern of an image

### 4.3.2 Pattern matching with grayscale processing

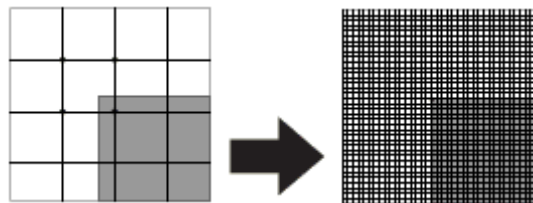
Grayscale image is image which contains shades of different levels from black to white. For pattern matching algorithm the image format must be grayscale type. For 8-bits grayscale image there are  $2^8 = 256$  levels available. In contrast, binary image processing recognizes images only as black and white. Fig 4.2 shows pattern matching with grayscale image.



**Figure 4.2:** Pattern matching with grayscale image

### 4.3.3 Sub-pixel processing

Sub-pixel processing means processing at more lower level for example sub-pixel processing method performs position detection in units down to 0.001 pixels whereas general image processing is performed in units of 1 pixel [6]. So the accuracy of position detection will increase this results to expand the range of precise part location and dimension measurement.



The vertex position cannot be detected accurately    The vertex position can be detected    accurately

**Figure 4.3** Sub-pixel processing

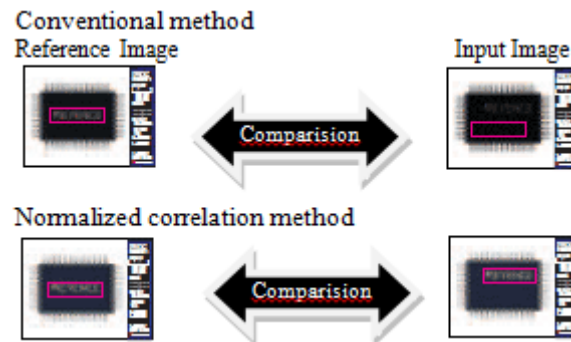
### 4.3.4 Normalized correlation method

Pattern matching should be done without affected by changes in brightness. Because we cannot determine the brightness at different times and different places. Here grayscale format is easy format to recognize by using pattern matching. It recognize each pixel of a reference image pattern as one of 256 levels of gray. This data is compared with the information of image on the screen so that it can detect the position. Due to variation in ambient light sometimes it is difficult to detect the accurate position.



**Figure 4.4:** Correlation method

To remove the error from correlation method that is affected by ambient light we use normalized correlation method. For both reference image and input image the average brightness of the image is subtracted from the brightness of each pixel. This process can be done in only grayscale image. This process is called normalization, that eliminates the difference in brightness of whole image. At the input best match and its position of the target pattern in the image is accurately determined.



**Figure 4.4:** Normalized correction method

Use of pattern matching method in recognition

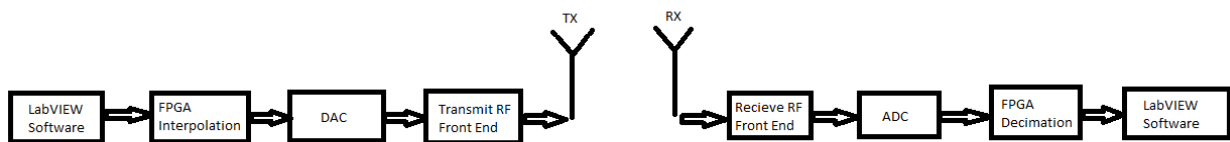
- Inspection for scratches of the surfaces of bathtubs
- Used in applying adhesives correctly and evenly.
- Used in Guiding robots so that they can adapt to changes in their environment
- Used in Checking whether airbags have been properly installed into cars
- Used in Checking paper in the production process for flaws
- Used in Making sure that syringes are manufactured properly.
- Used in Finding irregularities on flat glass.
- Used in Verifying that welds are strong enough.
- Used in Reading license plates of cars.
- Used in Recognizing and identifying persons.
- Used in Reading addresses on parcels and checking their dimensions

# Chapter 5

## WIRELESS TRANSCEIVER

### 5.1 Introduction

In recent years, wireless networks have been wide range of applications in recent years, since as compared to conventional wired networks, the installation of wireless networks are easier to install and cheap in installation. Wireless networks have many advantages over wired networks. Due to great interest in research area and practical interest many improvements have been achieved in the field of wireless networks. Speed of communication is increased by adopting newer technology and improve the technique of communication. For example the data rate in 802.11b wireless LAN was 1Mbps which has been increased to 54 Mbps in 802.11a. In point to point transmission this new technique improve performance of wireless networks. In this project, we study about Multiple-Input, Multiple-output (MIMO) technique which is called as Multiple Packet Transmission (MPT). In this one sender can send more than one packet to different users simultaneously.



**Figure 5.1.** Basic block diagram of wireless transceiver

Fig 5.1 shows the basic block diagram of wireless transmitter and receiver. Left part represents wireless transmitter and right part represents wireless receiver.

### 5.2 Packet Transmission

In case of transmit the packets of data frame first thing is we have to convert the data packet in specified packet for synchronization. A data frame consist frame synchronization which includes a sequence of bits or symbols which indicate to receive the beginning and end of

payload data within the stream of symbols or bits it receives. Receiver ignore the data when it connected to system in middle of a frame transmission, until it detects a synchronization sequence. The synchronization sequence consist packet parameter, packet pads and blank frame. Packet parameter having four different parts which are for different purpose- Guard band, Sync sequence, Packet number and Data.

Guard band: A guard band is an unused component of the radio spectrum among radio bands, for the intention of avoid interference. It is a narrow frequency range that is used to divide two wider frequency ranges to make sure that both can transmit at the same time without interfering by way of each other. It is used in FDM (Frequency division multiplexing). This can be used in both wired and wireless communications, the advantage is that adjacent frequency bands on the same media can avoid interference.

Sync Sequence: Trustworthy frame synchronization in packet radio systems needs card choice of the frame sync word to reduce correlation side lobes and thus the probability of counterfeit sync. The preface or bit sync sequence instantaneously prior to the frame sync word will approved this choice.

Packet number: It specify the serial number of current frame which is transmitting.

Data: In this part original data to be send in media.

For sending the data for long distance modulation of message signal is required. Modulation is the process of varying the properties of a signal with respect to other signal, this signal is called the carrier signal, with respect to a modulating signal that normally includes information to be transmitted. Here I am transmitting digital data. So for digital transmission there are several type of modulations like ASK (Amplitude Shift Keying), FSK (Frequency Shift Keying), PSK (Phase Shift Keying).

## **5.3 Modulation Schemes**

PSK (Phase Shift Keying)

PSK is a digital modulation scheme that express data by varying, or modulating, the phase of a reference signal or the carrier wave.



Any digital modulation scheme apply a fixed number of distinct signals to signify digital data. PSK uses a fixed number of phases, every one assigned a distinctive pattern of binary digits. All phase encodes an identical number of bits. All patterns of bits forms the symbol that is stand for by the particular phase. The demodulator, that is designed especially for the symbol-set used by the modulator, conclude the phase of the received signal and plot it back to the symbol it signify, therefore recovering the original data

### 5.3.1 BPSK (Binary Phase Shift Keying)

BPSK (Binary Phase Shift Keying) is the simplest type of phase shift keying (PSK). It have two phases that are separated by  $180^\circ$  and so can also be termed 2-PSK or also called PRK, phase reversal keying. It does not mainly subject exactly where the constellation points are located, and in this figure they are shown on the real axis, at  $0^\circ$  and  $180^\circ$ . This modulation is the mainly strong of all the PSKs since it takes the highest stage of noise and distortion to produce the demodulator reach an incorrect decision. So it is only able to modulate at 1 bit/symbol (as seen in the figure 5.2) and therefore is unsuitable for high data-rate applications.

In the occurrence of an random phase-shift launched by the communications channel, the demodulator is not capable to tell which constellation point is which one. As a result, the data is over and over again differentially encoded earlier to modulation

The general form for BPSK follows the equation:

$$S_n(t) = \sqrt{\frac{2E_b}{T_b}} \text{Cos}(2\pi f_c t + \pi(1 - n)), n = 0,1 \quad (1)$$

This yields two phases, 0 and  $\pi$ . In the specific form, binary data is often conveyed with the following signals:

$$S(t) = \sqrt{\frac{2E_b}{T_b}} \text{Cos}(2\pi f_c t + \pi)$$

$$S_0(t) = -\sqrt{\frac{2E_b}{T_b}} \text{Cos}(2\pi f_c t) \quad , \text{ for binary 0} \quad (2)$$

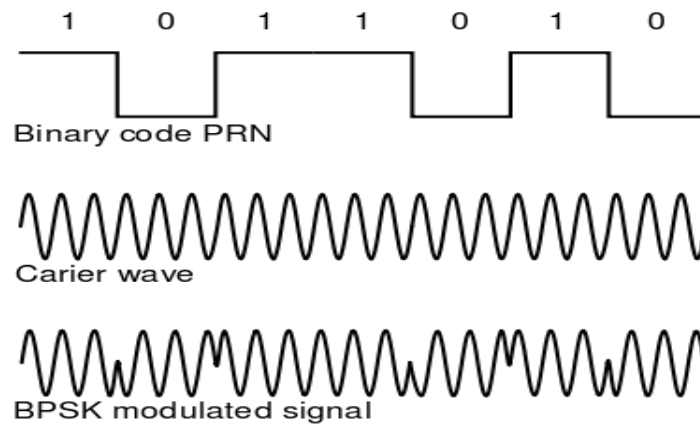
$$S_1(t) = \sqrt{\frac{2E_b}{T_b}} \text{Cos}(2\pi f_c t) \quad , \text{ for binary 1} \quad (3)$$

Where  $f_c$  is the frequency of the carrier-wave

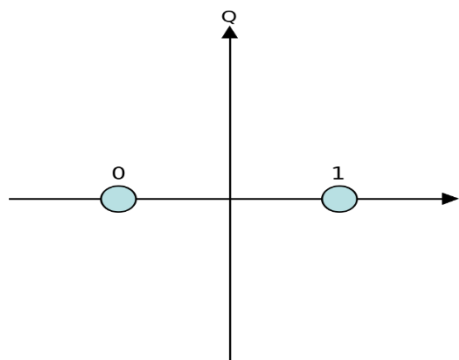
Hence, the signal-space is symbolized by the particular basis function:

$$\phi(t) = \sqrt{2/T_b} \cos(2\pi f_c t) \quad (4)$$

Where 1 is represented by  $\sqrt{E_b}\phi(t)$  and 0 is represented by  $-\sqrt{E_b}\phi(t)$ .

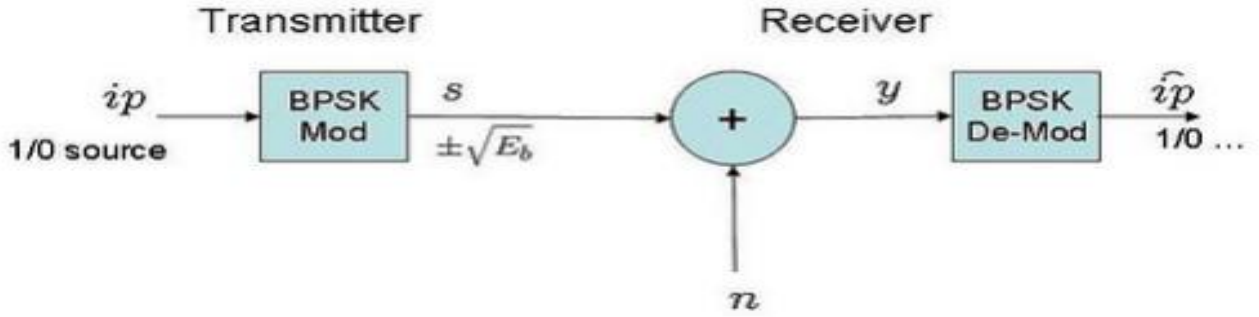


**Figure 5.2:** Signal representation in BPSK modulation



**Figure 5.3:** Constellation diagram of BPSK

In Binary Phase Shift Keying (BPSK) the information about the bit stream is contained in the transform of phase of transmitted signal. In case of BPSK, the binary digits 0 and 1 can be signify by the levels  $-\sqrt{E_b}$  and  $+\sqrt{E_b}$  respectively. The model of system is shown with fig 5.4.



**Figure 5.4: BPSK Model**

Bit error rate

The formula for calculating BER (Bit Error Rate) is given by:

$$P_b = Q\left(\sqrt{\frac{E_b}{N_0}}\right) \text{ or } P_e = \frac{1}{2} \operatorname{erfc}\left(\sqrt{\frac{E_b}{2N_0}}\right)$$

### 5.3.2 Quadrature phase-shift keying (QPSK)

QPSK (Quadrature Phase Shift Keying) is a form of phase shift keying. BPSK is a DSBCS modulation scheme with digital information for the message whereas QPSK is also a DSBCS modulation scheme but it sends two bits of digital information a time.

The quantity of radio frequency spectrum mandatory to transmit QPSK constantly is half that essential for BPSK signals, which in turn makes space for more users on the channel.

The realization of QPSK is more universal than that of BPSK and also indicates the realization of higher-order PSK.

$$S_n(t) = \sqrt{\frac{2E_s}{T_s}} \cos(2\pi f_c t + \pi/4(2n - 1)), \quad n = 0, 1, 2, 3 \quad (5)$$

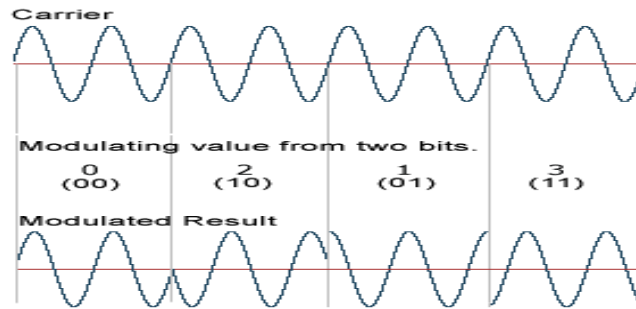
This yields the four phase's  $\pi/4$ ,  $3\pi/4$ ,  $5\pi/4$  and  $7\pi/4$  as needed.

This results in a two-dimensional signal space with unit basis functions

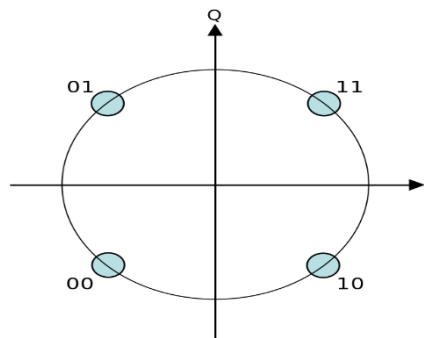
$$\phi_1(t) = \sqrt{\frac{2}{T_s}} \cos(2\pi f_c t) \quad (6)$$

$$\phi_2(t) = \sqrt{\frac{2}{T_s}} \cos(2\pi f_c t) \quad (7)$$

The initial basis function is used as the in-phase (I) component of the signal and the next as the quadrature (Q) component of the signal.



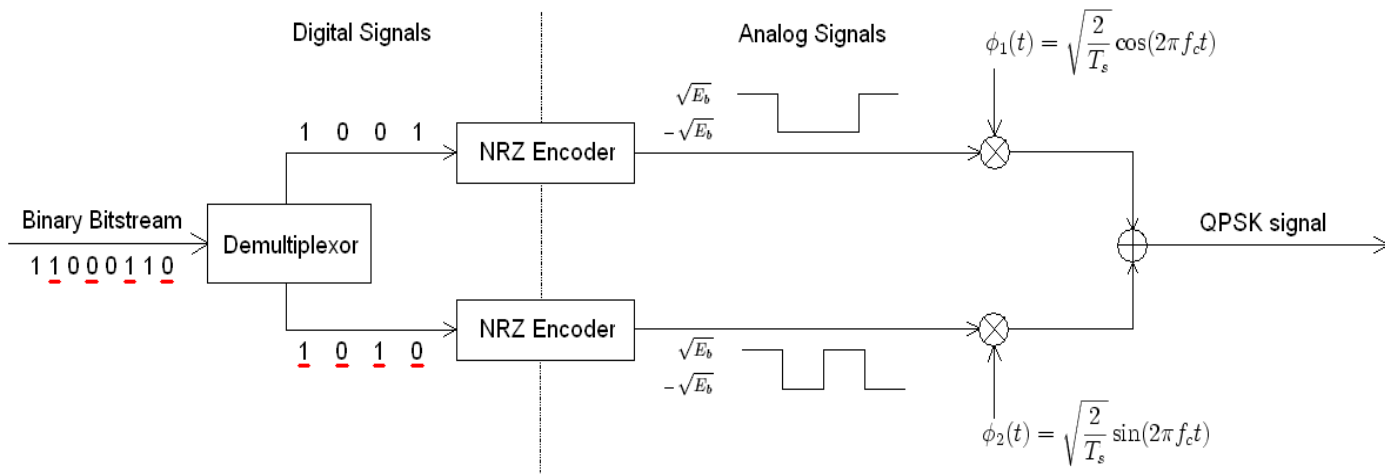
**Figure 5.5:** Signal representation in QPSK modulation



**Figure 5.6:** Constellation diagram of QPSK

**QPSK Transmitter:**

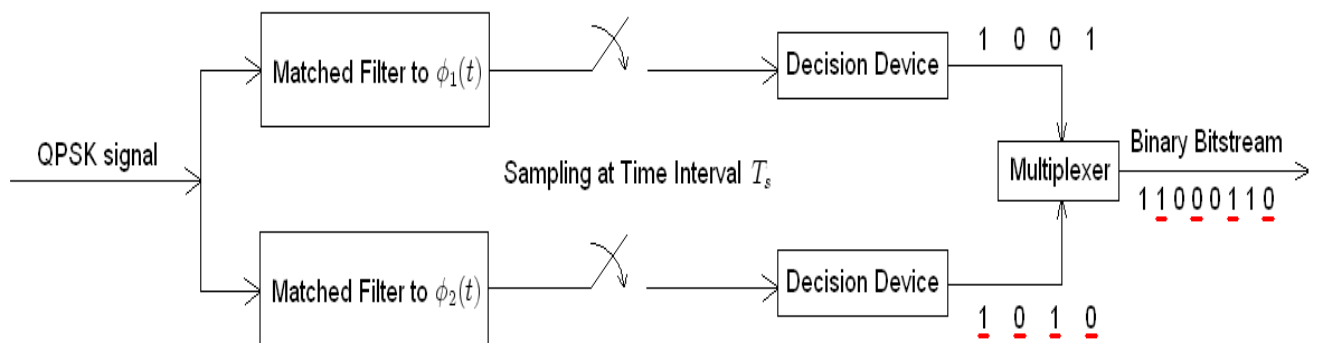
In QPSK binary data stream is divided into the in-phase components and quadrature-phase components. The components are then individually modulated onto two orthogonal basis functions. In this realization, two sinusoidal signals are used. After that, the two signals are overlay, and the resulting signal is the QPSK signal. In this implementation polar non-return-to-zero encoding is used.



**Figure 5.7: QPSK Transmitter**

QPSK Receiver:

In QPSK (Quadrature Phase Shift Keying) the matched filters can be replaced with correlators. Each detection device uses a reference threshold value to decide whether 0 or 1 is detected.



**Figure 5.8: QPSK Receiver**

Bit error rate

Even though QPSK can be analyzed as a quaternary modulation, it is easier to observe it as two separately modulated quadrature carriers. BPSK is used on both carriers and they can be independently demodulated.

As a result, the probability of bit-error for QPSK is the same as for BPSK:

$$P_b = Q\left(\sqrt{\frac{2E_b}{N_o}}\right) \quad (8)$$

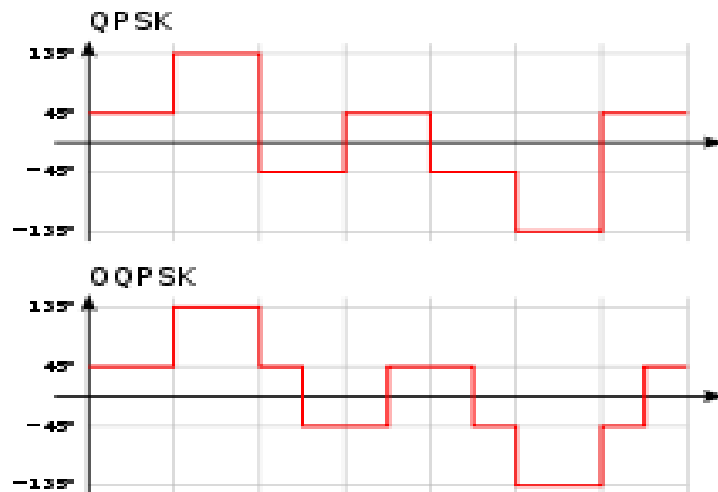
The formula for symbol error rate is:

$$P_s = 1 - (1 - P_b)^2$$

$$P_s = 2Q \left( \sqrt{\frac{E_s}{N_o}} \right) - \left[ Q \left( \sqrt{\frac{E_s}{N_o}} \right) \right]^2 \quad (9)$$

### 5.3.3 Offset QPSK (OQPSK)

OQPSK (Offset quadrature phase-shift keying) is a modification of phase-shift keying modulation using four dissimilar values of the phase to transmit. Sometimes it is also called *staggered quadrature phase-shift keying (SQPSK)*.

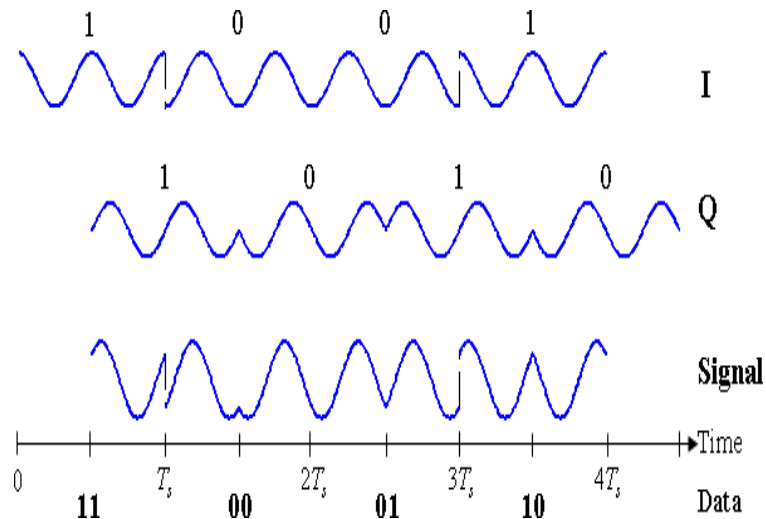


**Figure 5.9:** Difference of the phase between QPSK and OQPSK

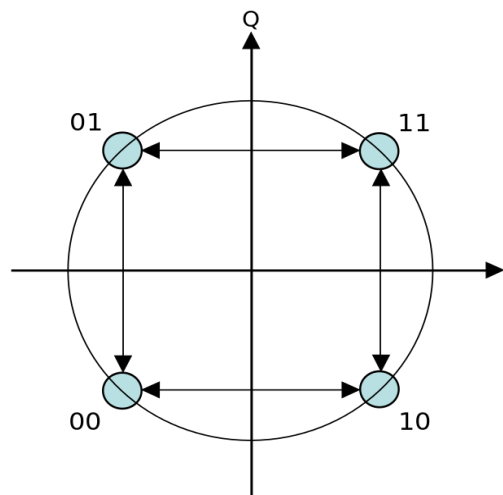
If we take four values of the phase (two bits) to construct a QPSK symbol at a time can permit the phase of signal to skip by as much as  $180^\circ$  at a time. As the signal is low-pass, these phase-shifts outcome is large amplitude fluctuations and an undesirable quality in communication systems. In the constellation diagram shown in the fig 5.10, we can observe that this will bound the phase-shift to not more than  $90^\circ$  at a time. This gives a lot lower amplitude fluctuations than non-offset QPSK.

Fig 5.11 shows the difference in the performance of the phase between ordinary QPSK and OQPSK. We can see that in the first plot the phase can alter by  $180^\circ$  at once, whereas in OQPSK the changes are not at all greater than  $90^\circ$ .

The modulated signal is shown in fig 5.11 for a small segment of a random binary data-stream. The half period of symbol offset between the two component waves. The abrupt phase-shifts take place about two times as frequently as for QPSK. In other words we can say that the magnitude of jumps is smaller in OQPSK compared to QPSK.



**Figure 5.10:** Timing diagram for offset-QPSK



**Figure 5.11:** Constellation diagram

The probability of symbol error can be written as if S/N ratio is high:

$$P_s \approx 2Q \left( \sqrt{\frac{E_s}{N_o}} \right) \quad (10)$$

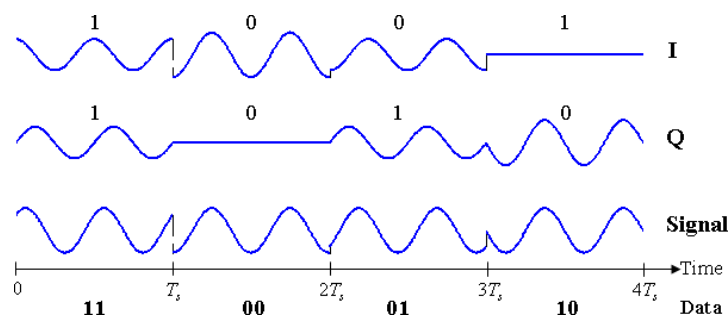
### 5.3.4 $\pi/4$ -QPSK

This type of QPSK have two alike constellations which are rotated by  $45^\circ$  with respect to each other. That why it is called as  $\pi/4$ -QPSK. Generally, To select points from one of the constellations or to select other symbols either the even or odd symbols are used select points from the other constellation. This also decrease the phase-shifts from a maximum of  $180^\circ$  to a maximum of  $135^\circ$ . Hence the amplitude fluctuations of  $\pi/4$ -QPSK are between non-offset QPSK and OQPSK.

The modulated signal is represented in the complex domain is the property of this modulation scheme, it does not have any paths through the origin. Hence the signal of OQPSK does not pass through the origin.

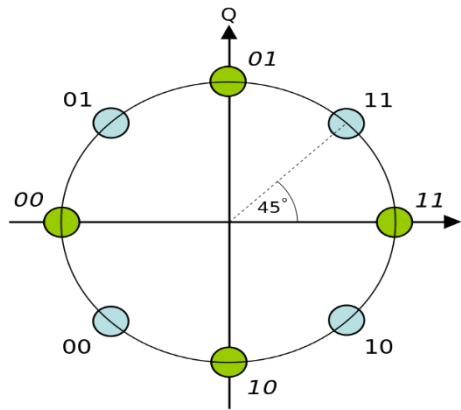
Other property is  $\pi/4$ -QPSK provide itself to easy demodulation so it has been adopted for use in, TDMA telephone systems is an example for this.

The signal which is modulated is shown below is for a short segment of a random data-stream. The construction is very similar to the ordinary QPSK. As shown in fig 5.14 two successive symbols are there. First symbol which is (1,1) is taken as 'blue' constellation and the second symbol which is (0,0) is shown as 'green component. Magnitudes of the two component alter whenever they switch between constellation but the magnitude of total signal remains constant that means constant envelope.



**Figure 5.12:** Timing diagram for  $\pi/4$ -QPSK





**Figure 2.13:** Dual constellation diagram

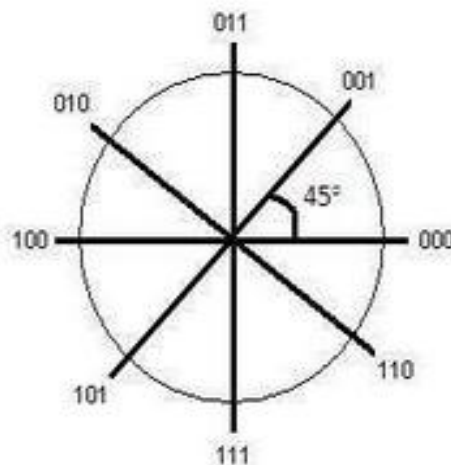
Figures shown above is separate constellations rotated by  $45^\circ$  with respect to each other.

### 5.3.5 8-PSK

8-PSK (Eight Phase keying) is a modulation method in which the signal transmit digital information on a carrier by changing the phase of the carrier. In case of 8-PSK there are eight separate phases which are changes defined, each phase change represents the transmission of 3 bits at a time. EDGE technology uses the 8-PSK.

The defined phase changes are- 0, 45, 90, 135, 180, 225, 270 and 315 degrees.

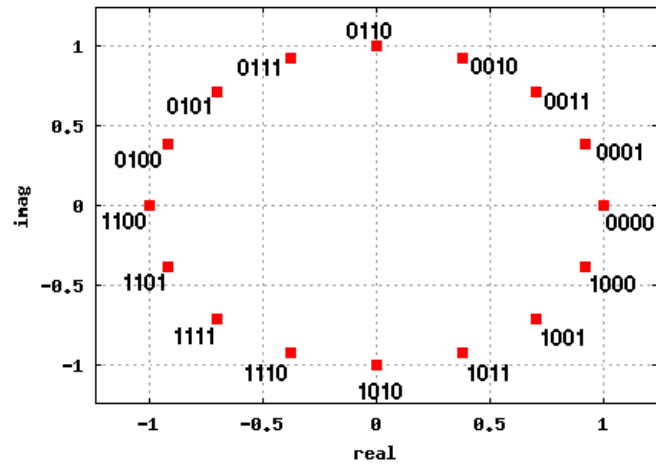
8-PSK provides more data capacity but it is less tolerant of link degradation than QPSK.



**Figure 5.14:** Constellation diagram for 8-PSK

### 5.3.6 16-PSK

16-PSK (Sixteen Phase Shift Keying) is a technique to transmit digital information on a carrier by varying the phase of the carrier. 16 different phase changes defined in 16-PSK, every phase variation represents the transmission of 4 bits.



**Figure 5.15:** Constellation diagram for 16-PSK

# Chapter 6

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## Design and Simulation

### 6.1 Introduction

In this project the objective is to design a system which includes image steganography encoder and decoder. For advanced security face recognition is provided and at last it will transmit it in air and then receive at receiver. At last one more application of face recognition is implemented which is Automatic attendance system. In this section of report we discuss about the complete procedure to implement the above.

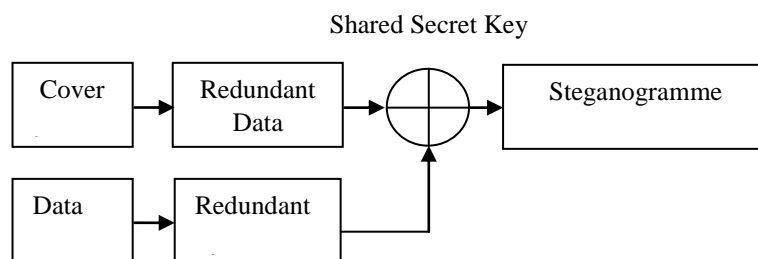
To keep the message secret there are different methods to encrypt the data one of these are cryptography. In cryptography the security was done by encryption and decryption of message. In case of steganography data information is hiding in cover information. Steganography overcomes the disadvantage of cryptography that the existence of message is also not visible because in some communications it is not enough to encrypt the data. In this paper Image steganography is implemented. Image steganography uses both data and cover information in image format. It hide the data information in a cover media without making any visible changes in it and the data media existence is concealed. To measure the performance of system two properties have to check first is difficult to determine the existence of data image and second is correlation between extracted and original image. Apart from them secondary properties are robustness and steganography capacity.

In this project advanced security is provided using faces recognition, So that only authorized person can access the data. For face recognition we need a camera for real time video of face of a person who is going to access the data image. Implementation of face recognition is done in LabVIEW software. The logic used for face recognition is pattern matching. In this method the template pattern is stored in LabVIEW buffer and when the same face comes in front of camera then it allow to access the data only if the key is available with the user. So here we are giving dual protection one through face recognition and second through key provided.

## 6.2 Implementation of Steganography

### 6.2.1 Encoder

The first process in steganography is encoding the data image in cover image[3]. Data image is secret message which should be invisible to third person. To hide the data image convert the image into pixels values in RGB format[4]. Both the data image and cover image converted into three  $2 \times 2$  matrix corresponding to Red, Green and Blue components. Each values of matrix of data image has been search into corresponding cover image and store it into global variable. So three global variable obtained these can be used as key for decoding the image. Fig. 6.1 shows the process involved in encoding a data image in a cover image.



**Figure 6.1:** Encoding Process

### 6.2.2 Decoder

Decoding is the process when a person wants to recover the original data from encoded data.

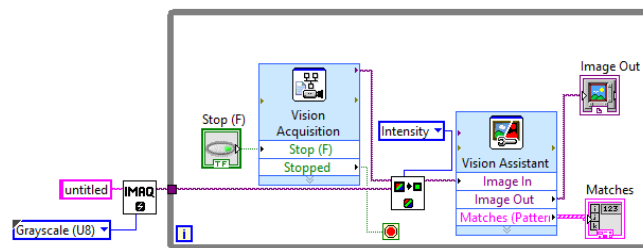
#### 6.2.2.1 Face recognition

First authentication is face recognition [5] i.e. the authorized person whose face pattern is stored previously in LabVIEW buffer can only access the data. For the recognition and detection of face pattern recognition is a useful technique. This algorithm becomes simple and accurate for finding a template in an image. Along with the searches of exact apparition of image this algorithm also finds a definite status of variation with respect to exact pattern. The simplest method of pattern recognition is the template matching.

Definition of image M is the difference function between segments of the image:

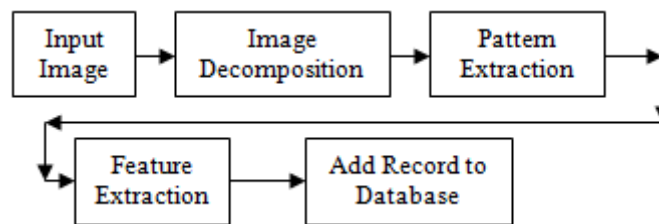
$$M(x, y) = \sum_{a=0}^w \sum_{b=0}^h (P(a, b) - A(x+a, y+b))^2 \quad (11)$$

In Fig. 6.2 shows the block diagram of acquiring the video and the pattern recognition system. Here for continuous acquisition from the camera with acquisition option of inline processing was used; hence a while loop is present inside the blocks of video acquisition. First of all the important thing is to transform the acquired video into intensity values or gray scale image [6]. One option is to change RGB values to intensity values is by using IMAQ extract single color plane available in vision utilities/color utilities. The input for pattern recognition function will be these converted intensity values.

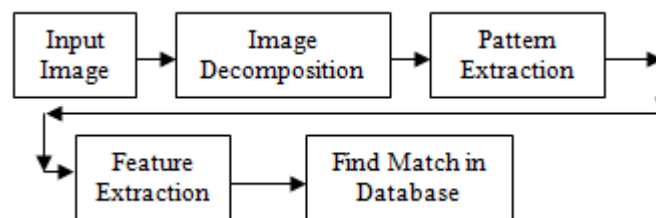


**Figure 6.2:** Block Diagram of pattern recognition

The block diagram of face recognition using pattern recognition method is given in fig. 6.3 and fig. 6.4.



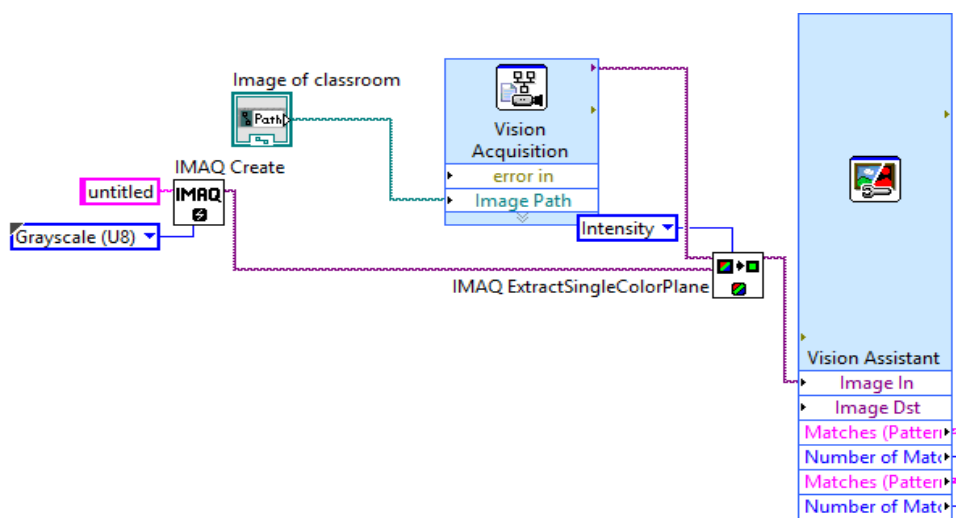
**Figure 6.3:** Procedure for feature extraction



**Figure 6.4:** Procedure for recognition

In the fig. 6.5, it is shown that two express VI's used (vision acquisition and vision assistant) [8]. Vision acquisition is used to acquire the real time image from camera. Path of the camera is given inside the configure block of vision acquisition. IMAQ create function is used for giving a name of acquired image and save temporary in LabVIEW buffer.

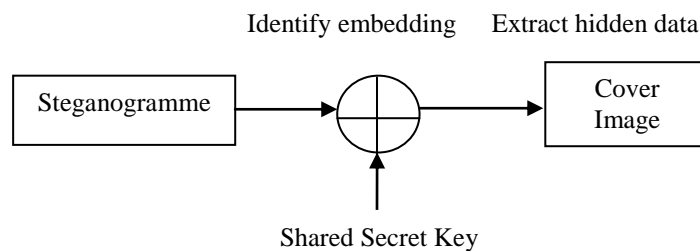
Acquired image is in the form of color image but pattern matching is done in gray scale image only because pattern matching is based on intensity level of pixel values of image [7]. So we must have to convert the color image into gray scale by using IMAQ extract single color plane. Then gray scale image is given to vision assistant express VI. It finally takes the decision that who is present and who is not.



**Figure 6.5:** Block diagram of image acquisition and processing

### 6.2.2.2 Decoding using key

Second authentication is key for decoding the data. Provided key is array of Red, Green and Blue pixel values. These arrays are used to search in whole image and the result will give data image. Fig. 6.6 shows the decoding process once face is recognized.



**Figure 6.6:** Decoding Process

Here the shared secret key is global variable which is obtained from encoder. Final data image received is created from cover image according to the location stored in global variable. Data image should not be greater in size that cover image and there should be some correlation between data image and cover image, so that the location of data image can be stored in global variable.

### **6.2.3 Procedure Involved**

#### **6.2.3.1 Encoding:**

- i. Choose the cover image from file location
- ii. Extract the pixel vale of cover image
- iii. Extract RGB Value of each pixel of cover image
- iv. Reshape the 2D RGB array of cover image to 1D array
- v. Take the Data Image through Vision acquisition
- vi. Extract the Pixel value of Data Image
- vii. Extract the RGB values of each Pixel of Data Image
- viii. Reshape 2D R ,G,B array of Data Image to 1D array
- ix. Extract the Column size and Row size of Data Image and send it to global variable
- x. Search each values of R,G,B of Data Image from the reshaped 1D R,G,B array of Cover Image and give its index value
- xi. Send these index value of RGB to global variable
- xii. Same Global variable used in decoding part

#### **6.2.3.2 Decoding**

There are two sub parts in decoding

1. Face Recognition
2. Decoding

## Face Recognition

- i. Take the image through vision acquisition
- ii. Send this image to Vision Assistant
- iii. In Vision Assistant we take the key feature or the part of image (face) which we have to match
- iv. Store this Pattern to pattern matching function
- v. In our project we take three patterns and we them as a key for decoding
- vi. We use OR gate after Vision Assistant so any of the pattern is matched then the output become high
- vii. We use case structure after output so if output become high then the true case will execute which is decoding part

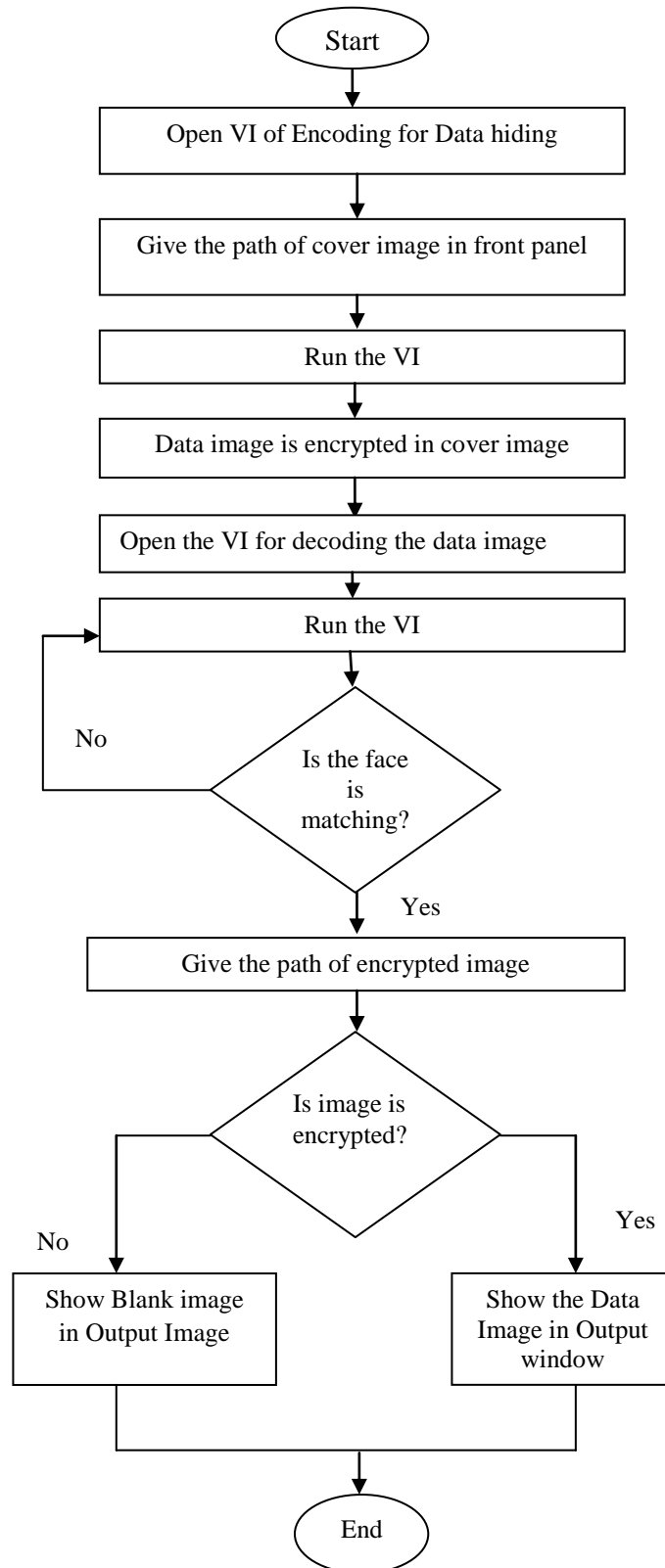
## Decoding:

- i. Take the same Cover Image used in Encoding VI
- ii. Extract the RGB values of each Pixel of Cover Image
- iii. Reshaping 2D RGB array of Cover Image to 1D array
- iv. Search the element of RGB of Data image from the Cover Image.
- v. Take the global variable for searching which is same in encoding part
- vi. It is helpful to extract 2D RGB values of data Image
- vii. Combine the RGB values and extract data image



### 6.2.4 Design Flow Chart of Process

The design flow diagram shown in the fig. 6.7 represents the whole process from top to bottom.



**Figure 6.7:** Flow diagram of whole process

## 6.2.5 Implementation and Result

LabVIEW (Laboratory Virtual Instrumentation Engineering workbench) [8] is a platform where an engineer can develop a logic inside a system and can also implement in system virtually with minimum hardware requirement. It is very user friendly and easy software to program any system without very deep knowledge of programming. The programming in LabVIEW [9] is graphical programming not a text based programming. Due to graphical programming syntax is not used so it is very easy to understand for an engineer. LabVIEW has two windows front panel and block diagram. Front panel has all the input and output present. This window is accessible to users, another window which in block diagram is responsible for programming [10]. All the logic is implemented here. This window is only accessible for programmer not for user.

### 6.2.5.1 Block Diagram of encoder

In the fig. 8 an encoder is implemented using LabVIEW software [11]. Data image and cover image are taken and converted into matrix of pixels values of R, G and B. Pixel values of data image search in pixel values of cover image and the location is stored in a global variable. This global variable is used as key for decoder. Upper part of fig is programming for extraction of cover image and lower part is for extraction of data image.

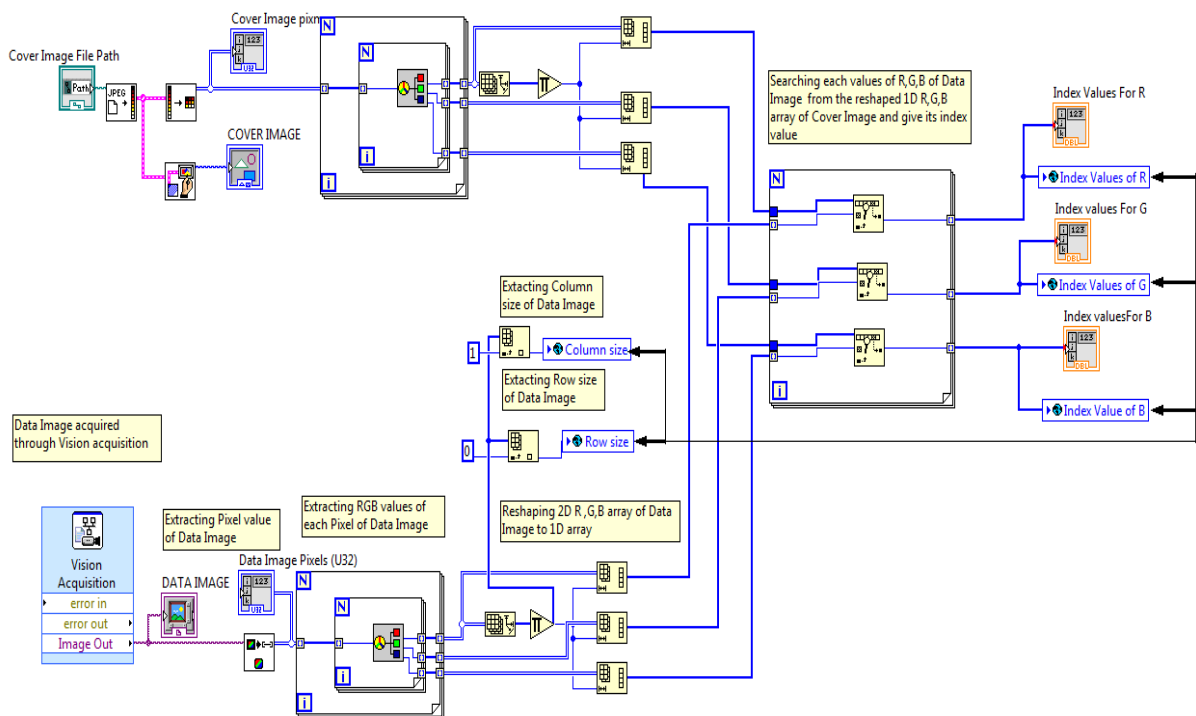


Figure 6.8: LabVIEW program for encoder

### 6.2.5.2 Front Panel of encoder

Fig. 6.9 shows front panel of encoder [12]. Two inputs images one is data image and another is cover image. Once both the input image is selected and run the program the encoding is done and pixel values of corresponding images will be shown on front panel. In the fig upper image is data image and lower image is cover image. Data image is encoded in cover image. Pixel values of data image and cover image is also shown.

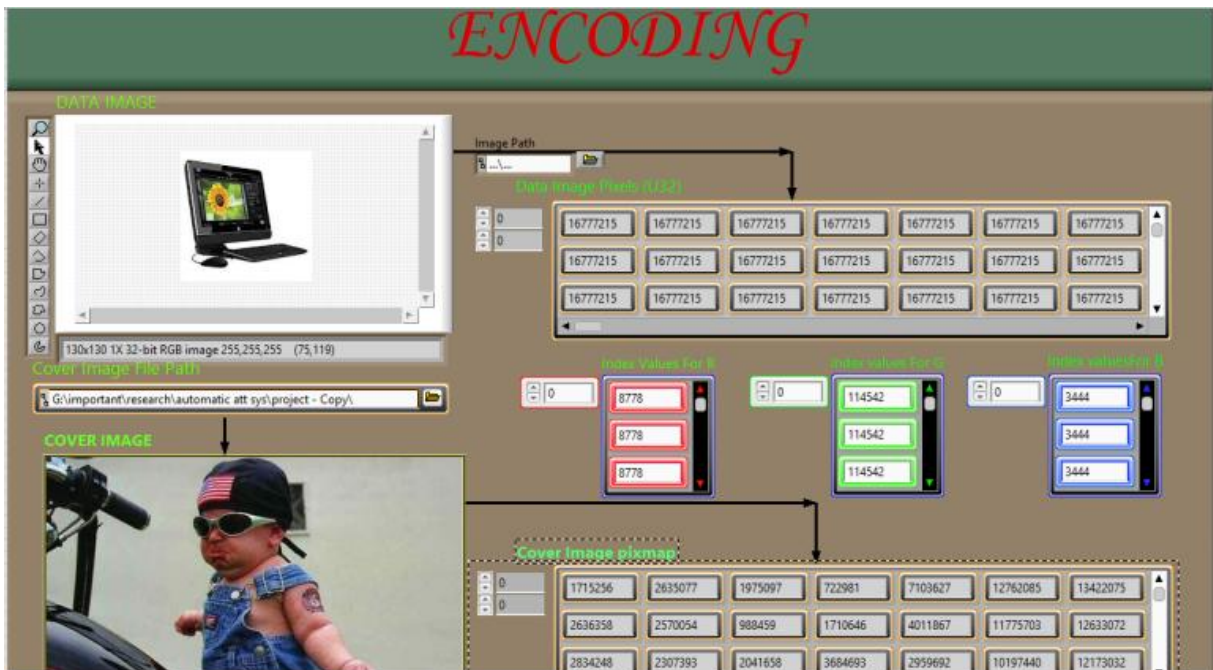
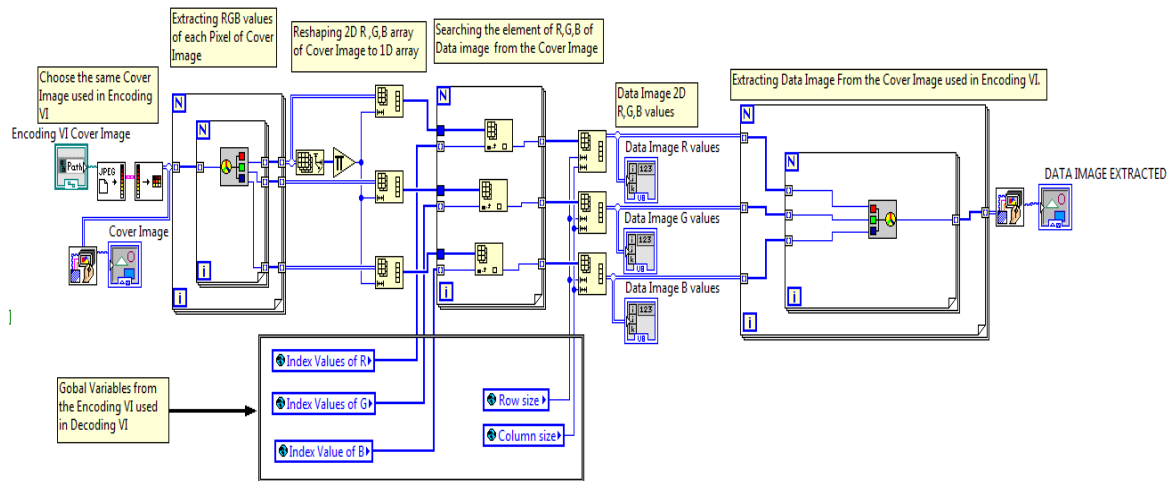


Figure 6.9: Front Panel of encoder

### 6.2.5.3 Block diagram of decoder

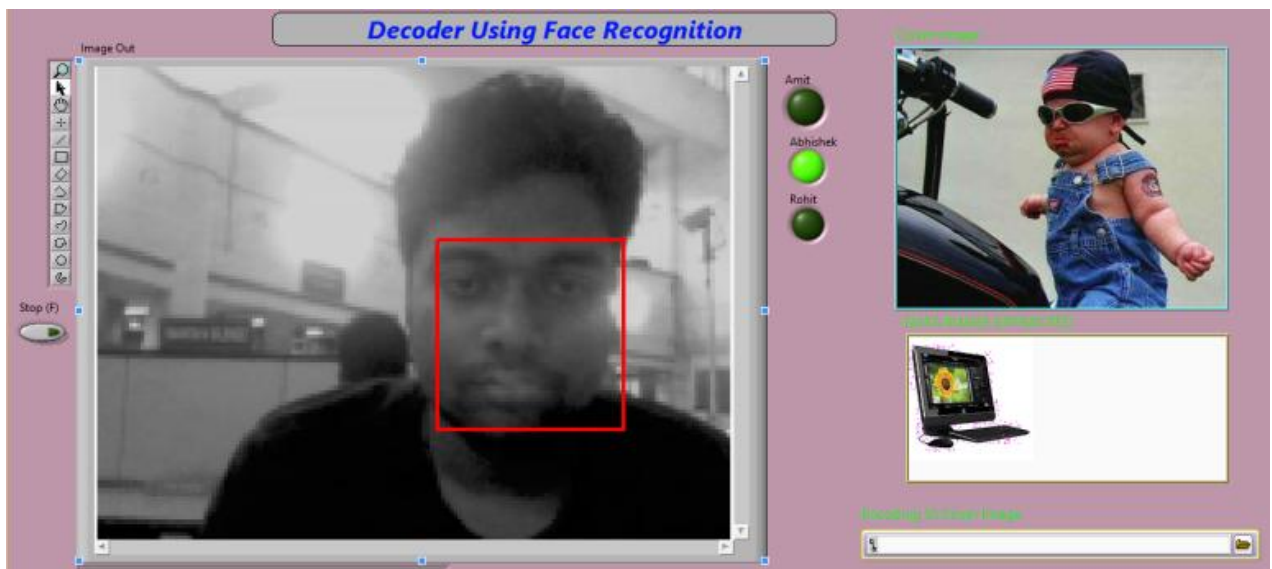
Fig. 6.10 shows decoder implemented in LabVIEW. The key which is global variable stored location of pixel values is used in decoder. Cover image is provided and according to location of pixel value a new image is constructed. This new image is very close to our data image.



**Figure 6.10:** LabVIEW program for decoder

### 6.2.5.4 Front Panel of decoder

Fig. 6.11 shows front panel of decoder. First process is face recognition [6] which is shown in fig. once the face is recognized then the encoded image given to input and global variable used as key. The first security is given as face recognition once face is recognized the remaining process will be done. Encoded image is given as input and output is data image.



**Figure 6.11:** Front Panel for decoder

## **6.3 Implementation of Transceiver using USRP**

### **6.3.1 Introduction**

In this project, we transmit different modulation schemes signal (such as QPSK, 8-PSK, 16-PSK, pi/4-PSK, and OQPSK) from TX1 i.e. from USRP1 and received the same to RX1 at USRP2 and their constellation diagram, eye diagram and bit error plots are shown by the LabVIEW. Comparison of BER among different modulation schemes is shown in this paper. Each modulation schemes have certain limitations. So according to application specific modulation scheme can be chosen. In the Software defined system, there is option of changing the types of modulation format from the software called LabVIEW. So, it is general purpose platform for basic communication system. Universal SDR is used as hardware for software defined system. It is the combination of hardware and driver software, which is proficient to transceiver signals in wide range of frequency, 0 – 5 GHz. However, frequency range depends on the USRP used.

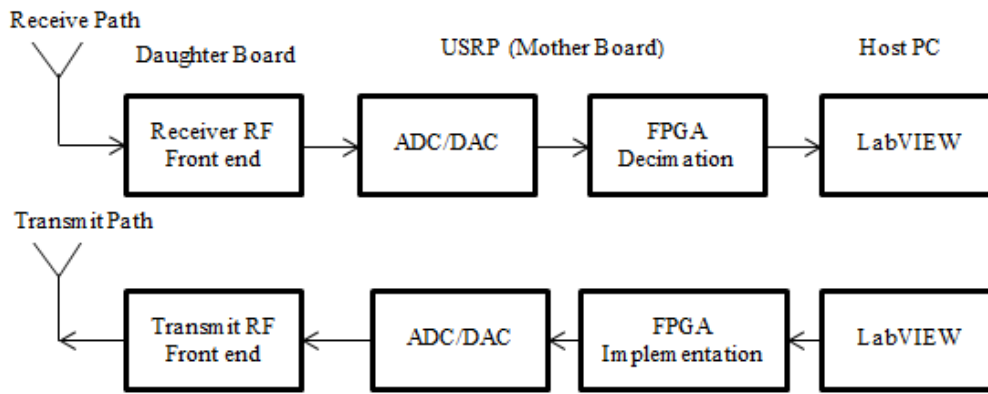
Following sections are given as; in the section 6.3.2 gives details of experimental platform i.e. about the hardware and software. In section 6.3.3, gives brief discussion on the modulation scheme. Implementation and results illuminated in the section 6.3.4.

### **6.3.2 Experimentation Platform**

#### **6.3.2.1 Hardware Platform**

Universal software defined radio (USRP), is nothing but a hardware board for software defined radio [7], consist of USB controller, ADC/DAC and FPGA[8].

The USRP board is coupled over Ethernet cable to the hosting PCs [10]. In the experiment, we used two host PC and two USRPs, from USRP1 signal is transmitted through antenna TX1 and received at the receiving antenna RX1 of USRP2 and the these parameters are used: IQ sampling 2M, carrier frequency 915 M, Gain 12dB, transmitter/receiver filter is root raised cosine, host PC IP address is 192.168.10.3 and USRP IP address is 192.168.10.2.



**Figure 6.12:** Basic SDR architecture

### 6.3.2.2 Software Platform

LabVIEW is visual programming language (i.e. graphical programming) from National Instruments (NI). It is generally used for data acquisition, industrial automation and instrument control. Windows 10 is used as OS (operating system) for the improvement platform. The program is executed from software to hardware through the Gigabit Ethernet cable.



**Figure 6.13:** Experimental setup of software defined radio

### 6.3.3 Modulation Scheme

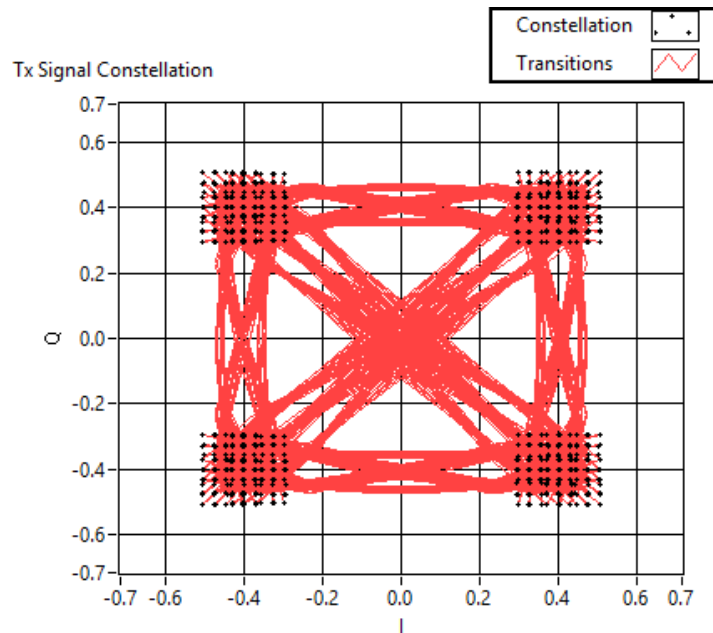
Different modulation schemes are transmitted through USRP1 at transmitting antenna TX1 and same signal are received at the RX1 of USRP2. Finite number of phases used in the PSK (phase modulation keying) and each phases allocated a distinctive configuration of binary

digits i.e. 0 or 1. Each phase of PSK encodes equal number of bits. Symbols i.e. represented by bits and represented by specific phase. In this paper, constellation diagram, eye diagram and bit error rate of different phase shift keying (PSK) are implemented such as quadrature phase shift keying (QPSK), M-ary phase shift keying (8-PSK, 16-PSK),  $\pi/4$ -phase shift keying ( $\pi/4$ -PSK), offset quadrature phase shift keying (OQPSK).

### **6.3.4 Implementation and Result**

The USRP is connected to a host PC to turn as a SDR. Incoming signals are mixed down using DCR (direct conversion receiver) with the help of SMA (subminiature version A) connector to baseband signal i.e. I/Q (in-phase/quadrature) components, that are sampled using 2-channel at the rate of 100 MS/s, 14-bit ADC (analog to digital converter). The encoded I/Q signals tracks parallel routes over DDC (digital down conversion) process. Filter and decimates input baseband signals at the rate of 100 MS/s to user at specific speed. The down converted samples signals passed through the host PV at the rate of 20 MS/s terminated a Gigabit Ethernet cable.

For broadcast, input baseband I/Q sampled signals are produced by host PC and inserted to the NI USRP-2920 (USRP, we have used in our experiment) through Gigabit Ethernet cable, when represented with 32-bits (i.e. 16-bits each for in-phase and quadrature components). USRP intercalates the input baseband signal to 400 MS/s using DUC (digital up conversion) procedure and then convert the incoming baseband signal to analog signal with dual channel, of 16-bit DAC. Then the consequential incoming analog signal mixed with quantified carrier frequency, 915 MHz. An available bit can enable to transfer up to 40 MS/s through Gigabit Ethernet cable between host PC and USRP, then incoming signal can transmitter through the USRP1 from TX1.

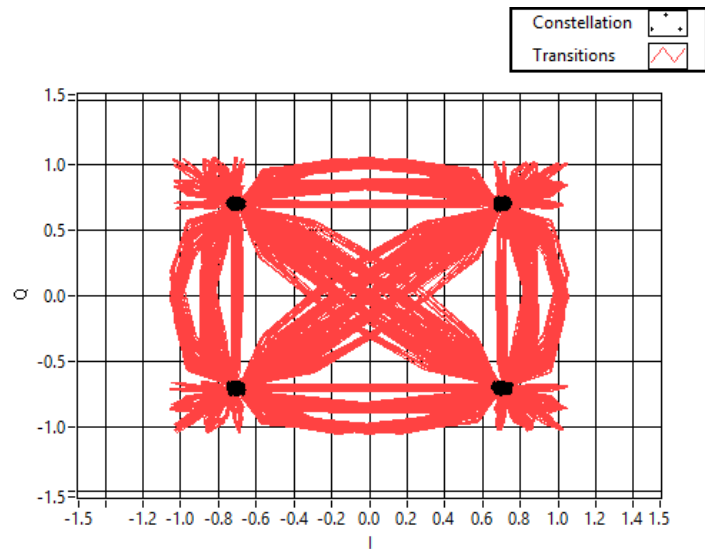


**Figure 6.14:** Constellation Diagram of QPSK at transmitter from USRP1

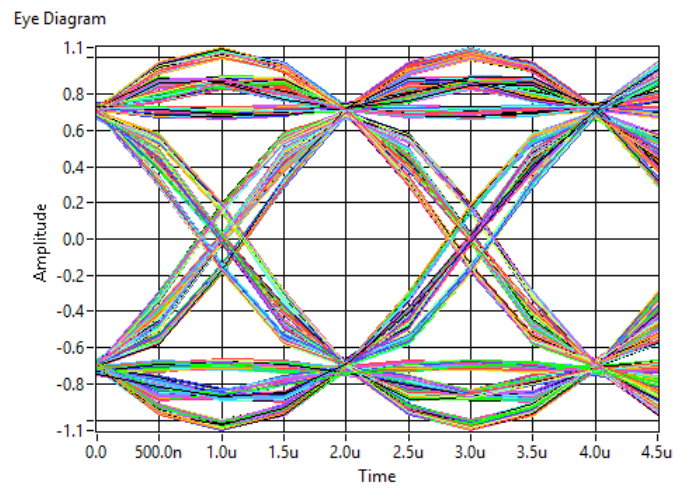
For transmitting packets of data frame, it has to be converted the data to specific packet for synchronization. In packet parameter, which include guard band, synchronization sequence, and packet number. All these parameter has to take into consideration while transmitting and receiving data/signal. Signal is transmitted through USRP1 from TX1 and received the same signal through USRP2 at RX1 as shown in the fig. 6.13.

From fig. 6.14 to fig. 6.17, plots the constellation diagram of transmitter, receiver, eye diagram and BER of QPSK respectively. Similarly, from fig. 6.18 to fig. 6.21, fig. 6.22 to fig. 6.25, fig. 6.26 to fig. 6.29 and fig. 6.30 to fig. 6.33 plots the constellation diagram of transmitter, receiver, eye diagram and bit error rate of 8-PSK, 16-PSK, pi/4-PSK, OQPSK respectively.

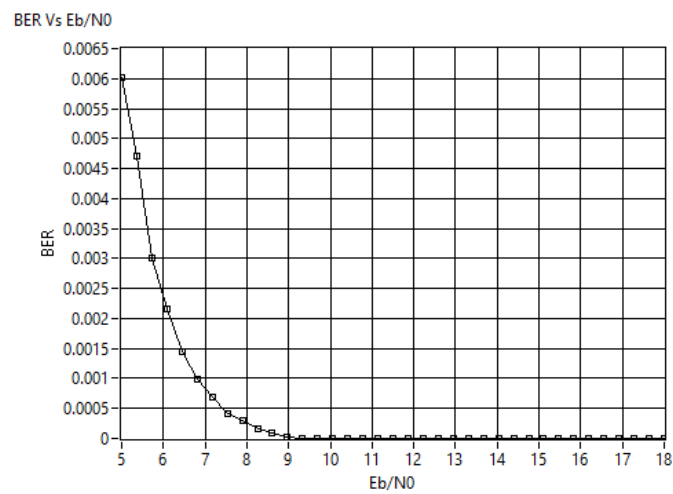




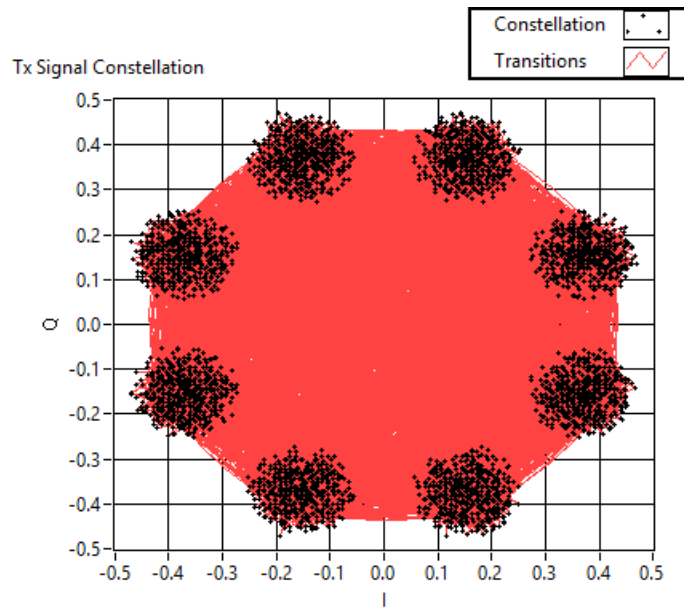
**Figure 6.15:** Constellation diagram of QPSK at receiver of USRP2



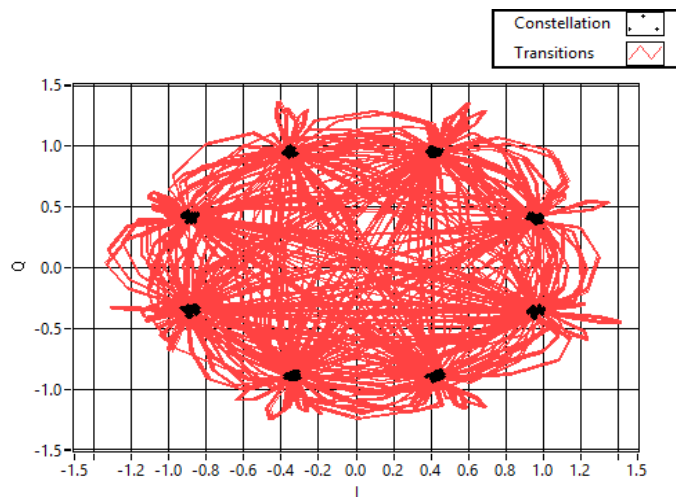
**Figure 6.16:** Eye diagram of QPSK at receiver of USRP2



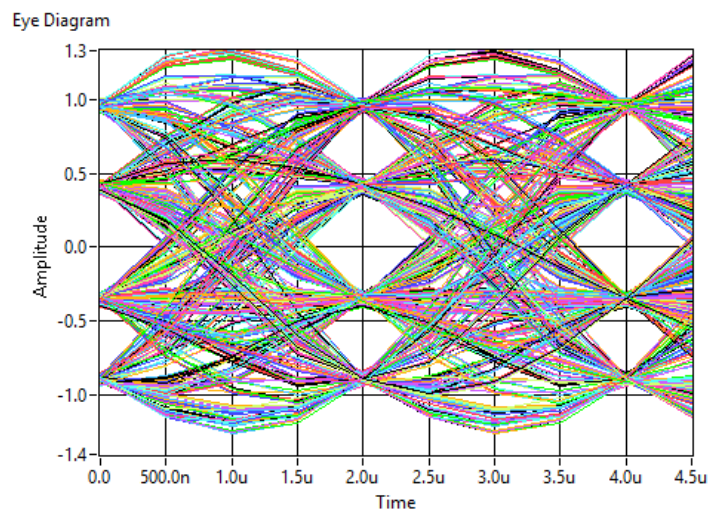
**Figure 6.17:** BER of QPSK at receiver of USRP2



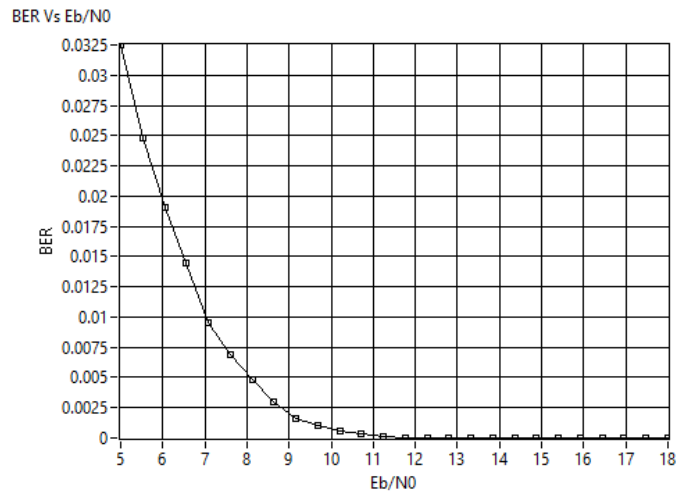
**Figure 6.18:** Constellation Diagram of 8-PSK at transmitter from USRP1



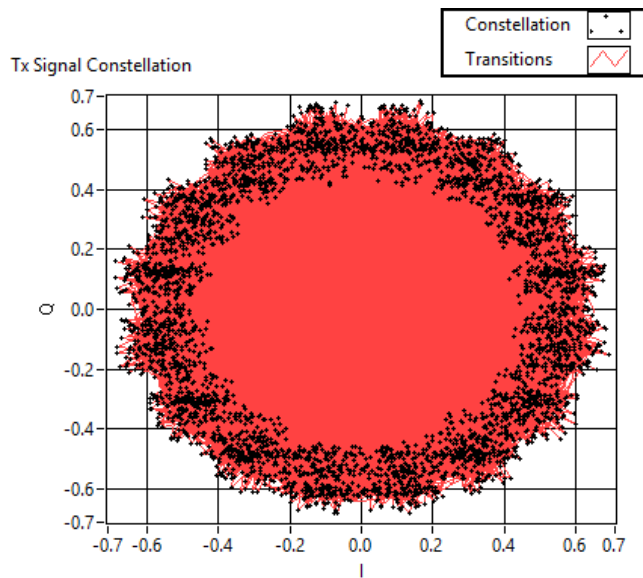
**Figure 6.19:** Constellation diagram of 8-PSK at receiver of USRP2



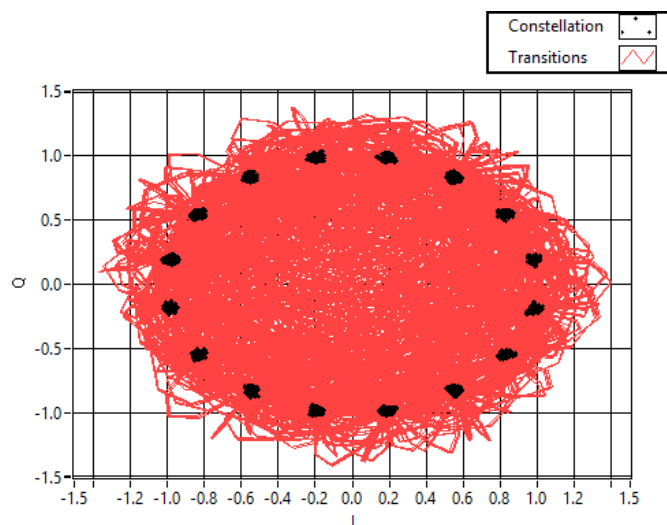
**Figure 6.20:** Eye diagram of 8-PSK at receiver of USRP2



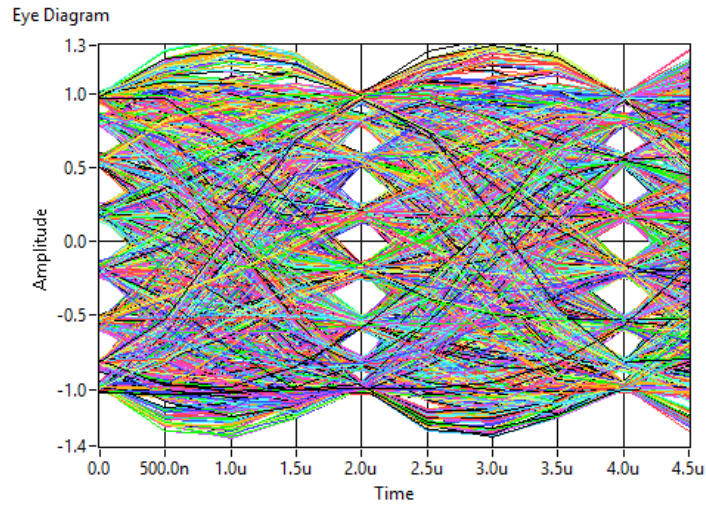
**Figure 6.21:** BER of 8-PSK at receiver of USRP2



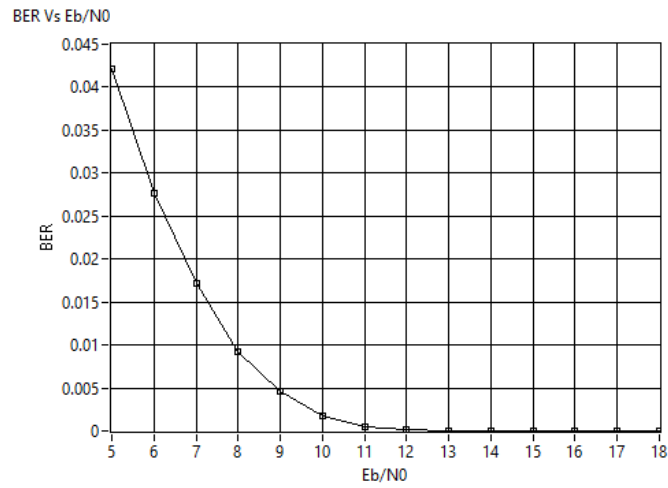
**Figure 6.22:** Constellation Diagram of 16-PSK at transmitter from USRP1



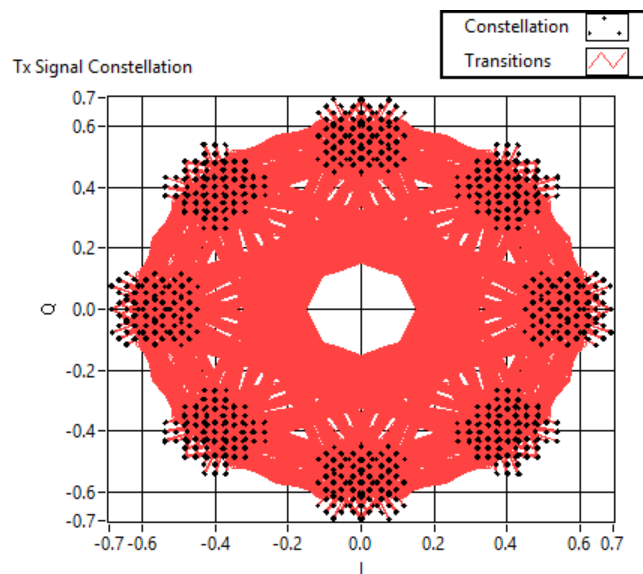
**Figure 6.23:** Constellation diagram of 16-PSK at receiver of USRP2



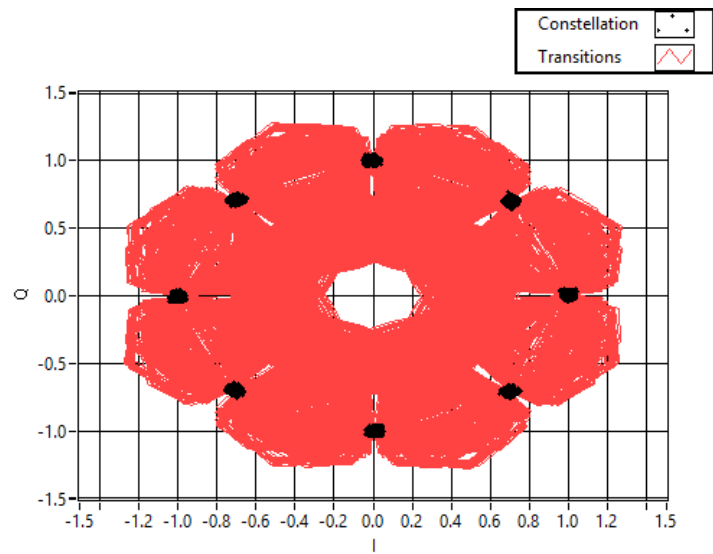
**Figure 6.24:** Eye diagram of 16-PSK at receiver of USRP2



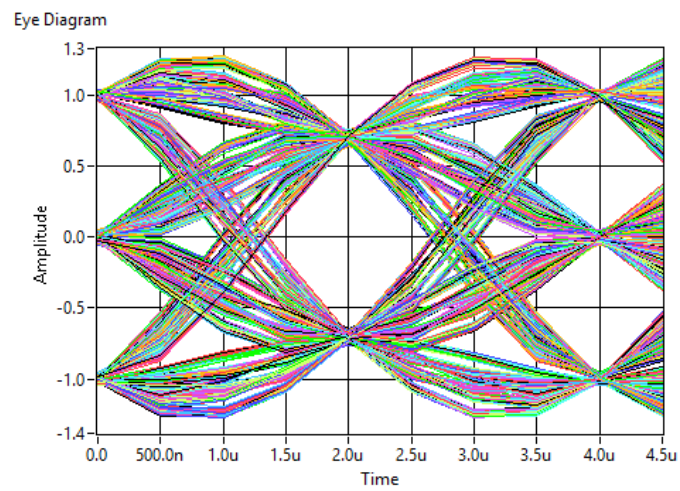
**Figure 6.25:** BER of 16-PSK at receiver of USRP2



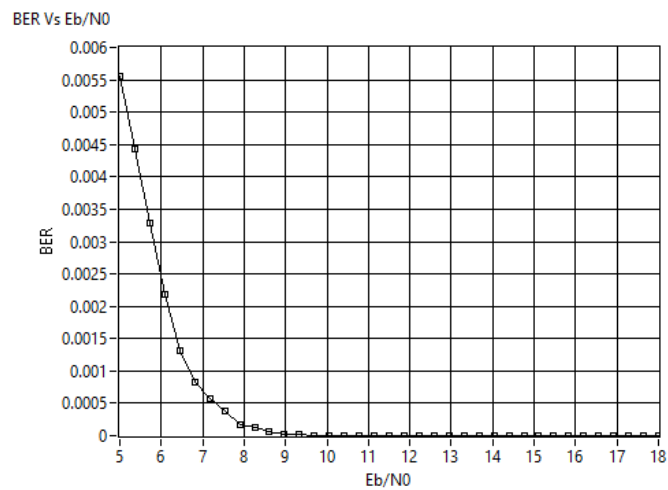
**Figure 6.26:** Constellation Diagram of pi/4-PSK at transmitter from USRP1



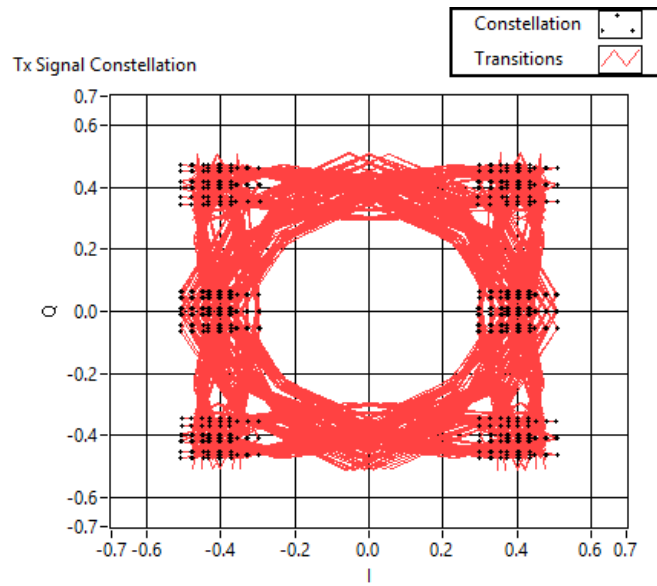
**Figure 6.27:** Constellation diagram of pi/4-PSK at receiver of USRP2



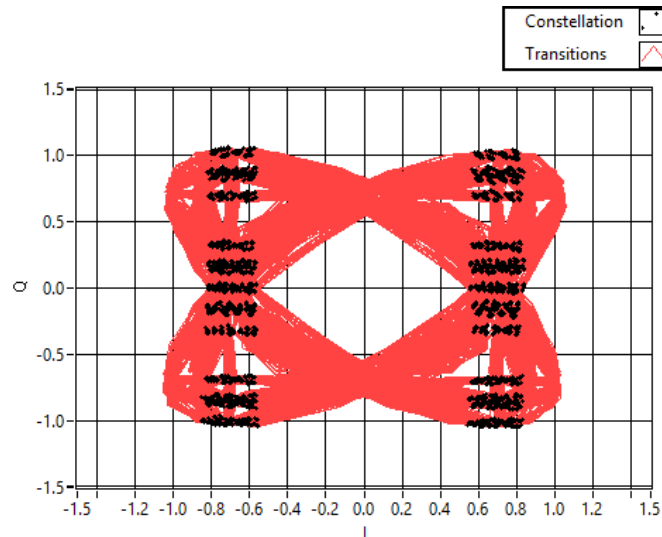
**Figure 6.28:** Eye diagram of pi/4-PSK at receiver of USRP2



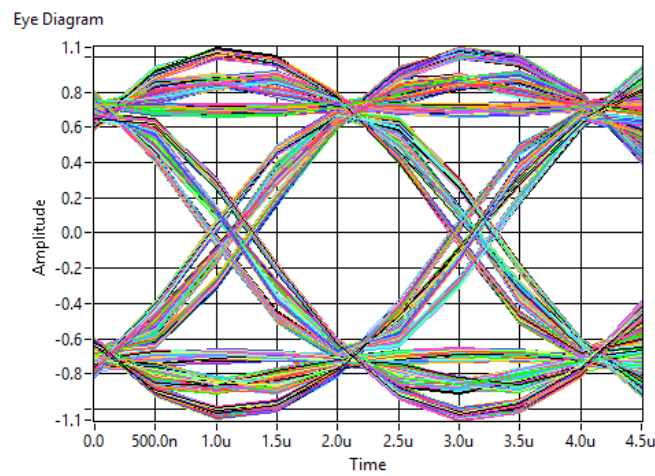
**Figure 6.29:** BER of pi/4-PSK at receiver of USRP2



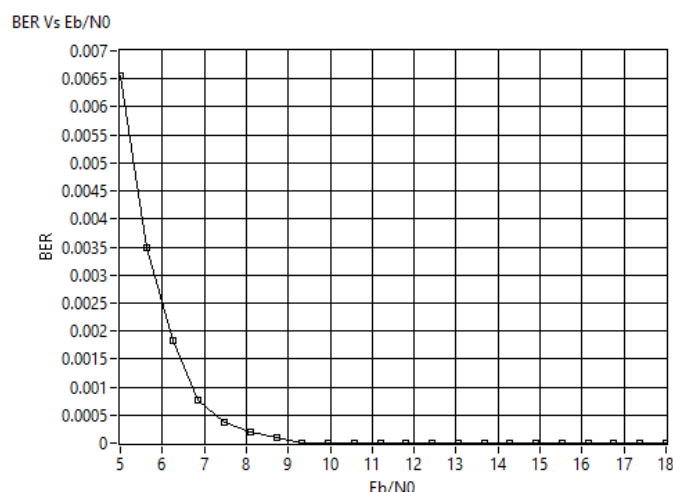
**Figure 6.30:** Constellation Diagram of OQPSK at transmitter from USRP1



**Figure 6.31:** Constellation diagram of OQPSK at receiver of USRP2



**Figure 6.32:** Eye diagram of OQPSK at receiver of USRP2



**Figure 6.33:** BER of OQPSK at receiver of USRP2

## 6.4 Implementation of Automatic Attendance System

### 6.4.1 Introduction

The Prevailing attendance system in the University works manually and is taken by the faculty or the course instructor by the Roll/Registration id call and the attendance is marked for every hour for the students and the responses are saved in an online interface being used for all the University purposes called the UMS or University Management System. This process is taking more time for attendance.

So for reduce this wastage of time this system of taking attendance can be used. Usually 3-5 minutes are wasted in conventional attendance system. But in this new system it is just taking 1-2 seconds in whole process of attendance. So it will to save the time.

In this process a camera is used in every classroom which is connected to PC on USB port. When faculty wants to take attendance he just has to switch on the process [2]. The attached camera will take a snap of whole class. It sends this image to PC and then it is decided that which student is present and who is not. PC operates an algorithm of image processing for taking decision for present and absent students. Using this approach it is allowed to store the captured image for later processing. After taking decision it created a excel sheet of present and absent students or it can also modify exist excel sheet or data.

The applications presented in paper consist in an attendance system which is capable to recognize face and monitor the present and absent students. By the use of modular realization

of both software and hardware parts [8], the system can be easily operated with multiple cameras.

In recent years, face recognition becomes very popular [5] and the research on it has rapidly increased by engineers. It has large applications in neuroscience. It has many features in computer vision, machine vision, communication, bio medical and automatic product inspection. Face detection plays critical role in face recognition [6-7]. It is first step for automatic face recognition. But, in case of face detection there are several variations like occlusion, orientation of image, variations of pose, facial expression, and orientation of image.

The organization of the rest of the paper is as follows. In section 6.4.2, describes the image acquisition. Mathematical representation of digital image is explained in section 6.4.3. Section 6.4.4 shows the pattern matching using LabVIEW.

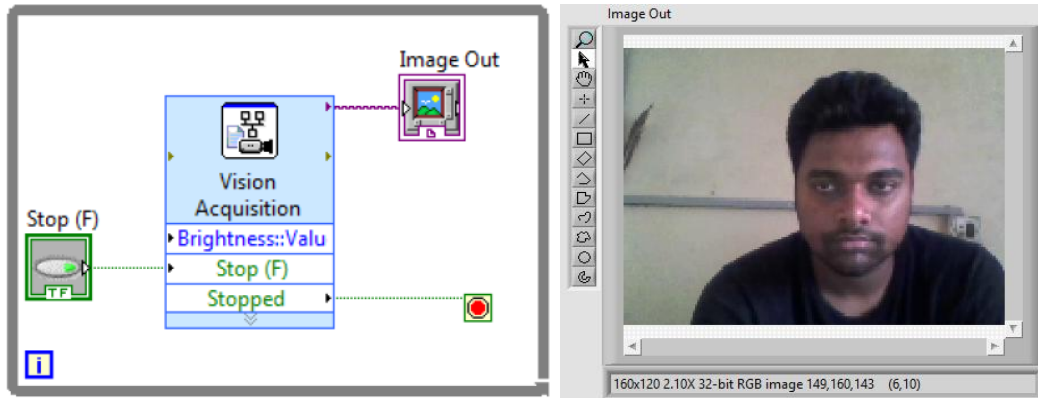
### **6.4.2 Image Acquisition**

Image is generally associated with light incident and reflected from scene. Hence, light distribution in the scene is one of variables in formation of images. Since the formation of image of any object depends of the interaction of the light with object in any scene and the energy emitted from one or different sources light changes in its trip.

In Fig. 1 it is shown that how to acquire video from a webcam by using LabVIEW and NI Vision Acquisition Express located in Vision/Vision Express toolbox. This method is the simplest way to acquire the image or video from camera and also to configure the camera. In NI Vision Acquisition configuration block four sections are there: the first section is the option of “select acquisition source” [2]. Inside this option it shows all the cameras connected with the computer which is used. We can select the required camera used. The second section is “select acquisition type” which determines that what should be the mode of display the image. It has four modes: single acquisition with processing, continuous acquisition with inline processing, finite acquisition with inline processing, and finite acquisition with post processing we can choose any one of these option according to our requirement. The next option corresponds to the “configure acquisition settings” it shows the constraints of camera like size, brightness, contrast, gamma, saturation, etc. of the image taken by camera. The fourth and last section is to select controls and indicators. In Fig. 6.34 continuous acquisition with inline processing is selected. It will acquire the image and display in continuous mode or



video mode. It will keep displaying the real time acquired image until the user presses the stop button.



**Figure 6.34:** Video Acquisition using IMAQ Vision Acquisition Express

### 6.4.3 Mathematical representation of digital image

An image is represented as an  $M \times N$  elements matrix [7]. The elements of matrix have a value which is corresponding to pixel values of digitized image of brightness of each and every point in acquired image.

Image can be of resolution in intensity 8 bits, 16 bits and so on. An image of 8 bits resolution in intensity has values from 0 to 255. For black and white image the values are either 0 or 1. In general, an image is represented in a bi dimensional matrix as shown in (12).

$$I = \begin{pmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \dots & x_{nn} \end{pmatrix} \quad (12)$$

According to the depth of acquired image from most of the cameras acquires with a depth of 8 bits so generally the range of gray scale levels is from 0 to 255 for an image so the elements of matrix represented by  $x_{ji} \in [0 \dots 255]$ . So from this concept we can say that the acquired RGB format image can easily transformed in gray scale image by using Grassman formula. Grassman formula is:

$$I_{gray} = I_R(0.299) + I_G(.587) + I_B(.114) \quad (13)$$

Where,  $I_{gray}$  = Gray scale image,  $I_R$  = Component of red in color image,  $I_G$  = Green component of color image,  $I_B$  = Blue component of color image

## 6.4.4 Pattern matching using labview

### 6.4.4.1 Pattern recognition

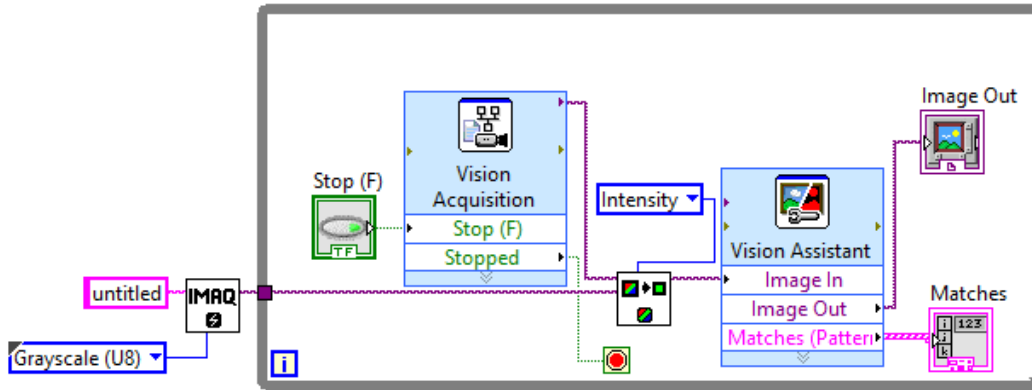
For the recognition and detection of object pattern recognition is a useful technique. This algorithm becomes simple and accurate for finding a template in an image. Along with the searches of exact apparition of image this algorithm also finds a definite status of variation with respect to exact pattern. The simplest method of pattern recognition is the template matching.

Definition of image M is the difference function between segments of the image:

$$M(x,y) = \sum_{a=0}^w \sum_{b=0}^h (P(a,b) - A(x+a,y+b))^2 \quad (14)$$

Where,  $M(x,y)$  = Final Image,  $P(a,b)$  = Template pixel values,  $A(x+a,y+b)$  = Pixel values of real time image

In Fig. 2 shows the block diagram of acquiring the video and the pattern recognition system. Here for continuous acquisition from the camera with acquisition option of inline processing was used; hence a while loop is present inside the blocks of video acquisition. First of all the important thing is to transform the acquired video into intensity values or gray scale image. One option is to change RGB values to intensity values is by using IMAQ extract single color plane available in vision utilities/color utilities. The input for pattern recognition function will be always gray scale image.

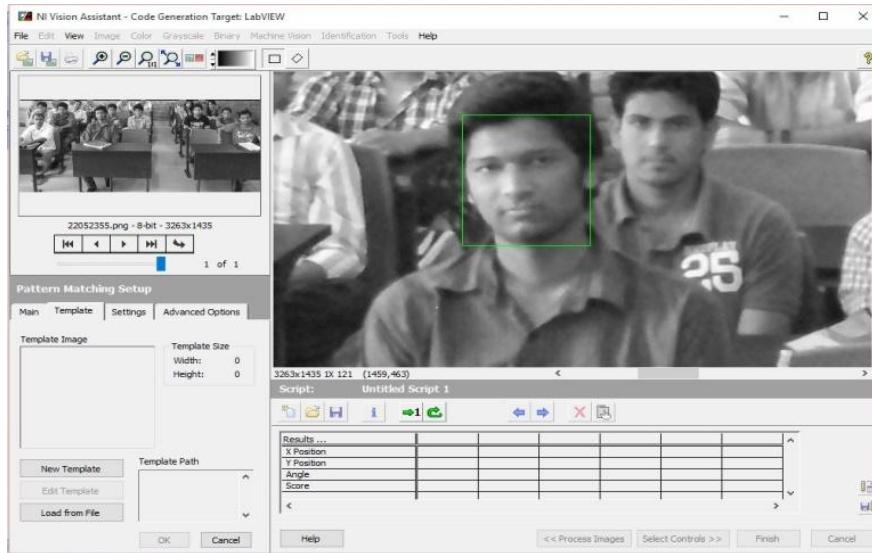


**Figure 6.35:** Block Diagram of pattern recognition

For pattern recognition the function available in LabVIEW is vision assistance. As shown in Fig. 6.36 machine vision function was selected. To create new template click in the option new template and the select required portion of image which we want to use as template as shown in Fig. 6.37.



**Figure 6.36:** Selection of pattern matching



**Figure 6.37:** Creation of new template

In last the vision assistant function which is having the pattern matching algorithm will identifies the desired object according to template in the whole in Fig. 6.38. At last when program will execute in real time it identifies the desired object in the whole image [2].

A remark is needed to obtain the recognized matches. The checkbox must be selected inside the control parameters. The output of vision assistant is a cluster that contains different information. This cluster can be unbundled to form a rectangular box which can locate the matches.



**Figure 6.38:** Recognition of template in whole image

#### 6.4.4.2 Procedure of face detection using LabVIEW

We easily detect a pattern from an image or a video. For this first of all we take a snap of original image then store the interested part in LabVIEW buffer [6]. In our project we have to detect the face so we take the snap of face of the person as shown in fig. 6.39. Store the pattern of that face in LabVIEW function Image Assistant. When we run the program and the same face (Pattern) comes in front of camera then it detects that pattern and gives result in the form of matrix.



**Figure 6.39:** Detecting key points of patterns

#### 6.4.4.3 Block diagram of face recognition

In this project, we are having all the database of the students in MS-Excel sheet. We store this data base in LabVIEW buffer. To acquisition of real time image from camera vision acquisition is used by giving the path of camera. After getting image use vision assistant express VI. Inside vision assistant pattern-matching function is there. Take the key parts of faces of each student inside this express VI [11].

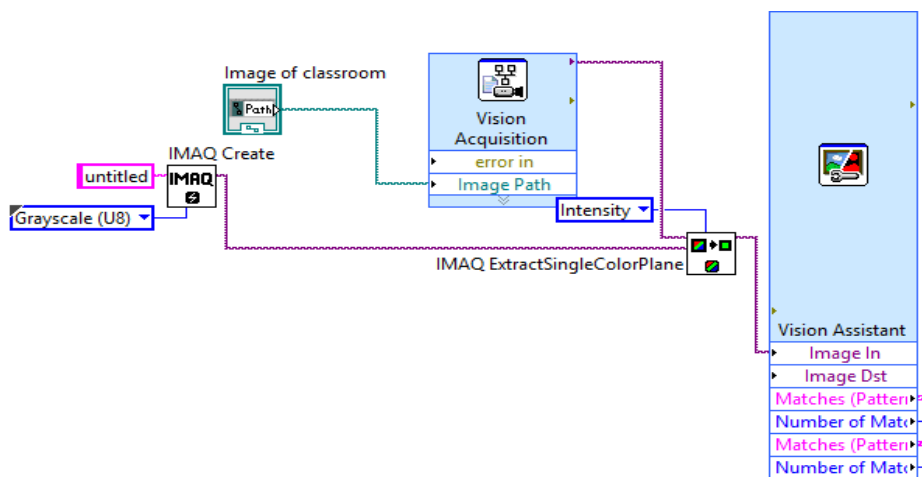
At the time of taking the attendance then click the start button, the camera is attached with the vision acquisition and takes the image of the class in top angle view. And after that taking image it sends this to vision assistance where all the reference images are saved. It compares each individual picture to the whole of the image of the class and gives the output as a matrix of 1 and zero with respect to each and every student. By using this matrix LabVIEW decide which student is present and which is not present (absent). The matched patterns of the students are marked as present and rest are marked as absent. After that we use the write to spread sheet, give the output list of present and absent students in an MS-Excel sheet.

#### 6.4.4.4 Block diagram of image acquisition and processing

In the fig. 6.40, it is shown that two express VI's used (vision acquisition and vision assistant) [10]. Vision acquisition is used to acquire the real time image from camera. Path of

the camera is given inside the configure block of vision acquisition. IMAQ create function is used for giving a name of acquired image and save temporary in LabVIEW buffer.

Acquired image is in the form of color image but pattern matching is done in gray scale image only because pattern matching is based on intensity level of pixel values of image. So we have to convert it into gray scale by using IMAQ extract single color plane. Then gray scale image is given to vision assistant express VI. It finally takes the decision that who is present and who is not.



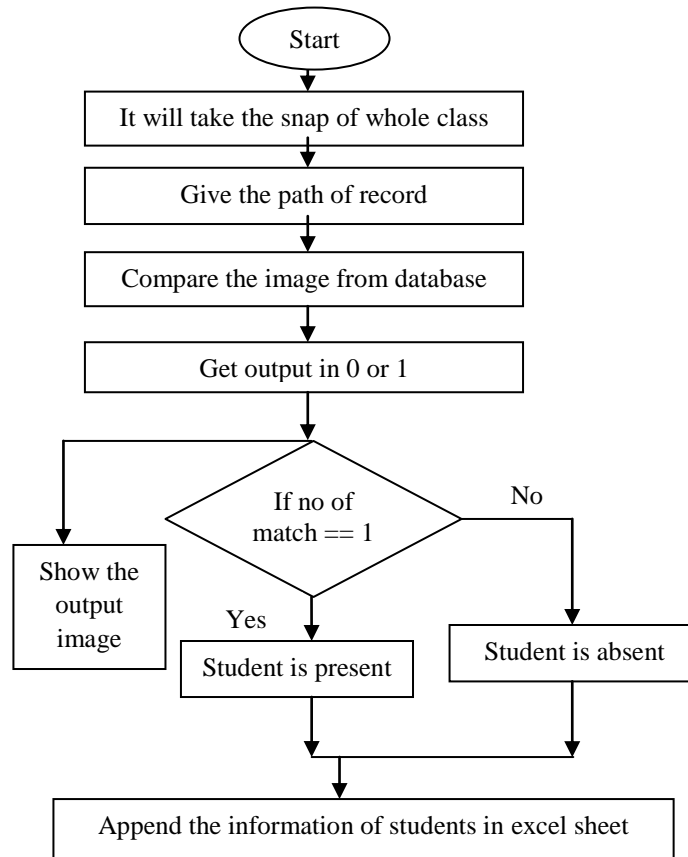
**Figure 6.40** Block diagram of image acquisition and processing

#### 6.4.4.6 Procedure involved

- i. Choose the image of class from a particular location.
- ii. Use a template which occupies the face of each student.
- iii. Give the Excel sheet path in which the student information will store.
- iv. The image which is acquired is in RGB format so we have to convert the image to gray scale format.
- v. Take the gray scale image and match it with template.
- vi. Use function “no. of matches” which gives the output 1 if pattern match otherwise 0.
- vii. If output is 1 the student is present otherwise absent.
- viii. By using this information generate the Excel sheet.

#### 6.4.4.5 Design Flow Diagram

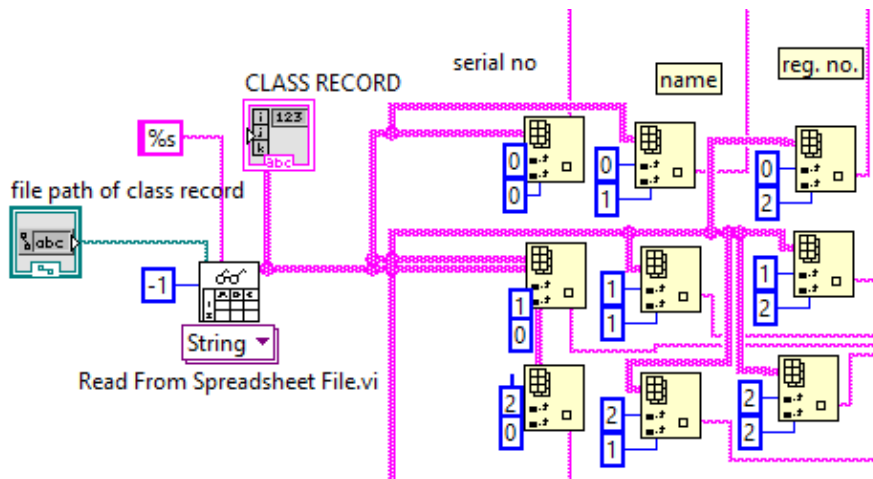
This design flow diagram shown in the fig. 6.41 represents the whole process from top to bottom.



**Figure 6.41:** Flow diagram of whole process

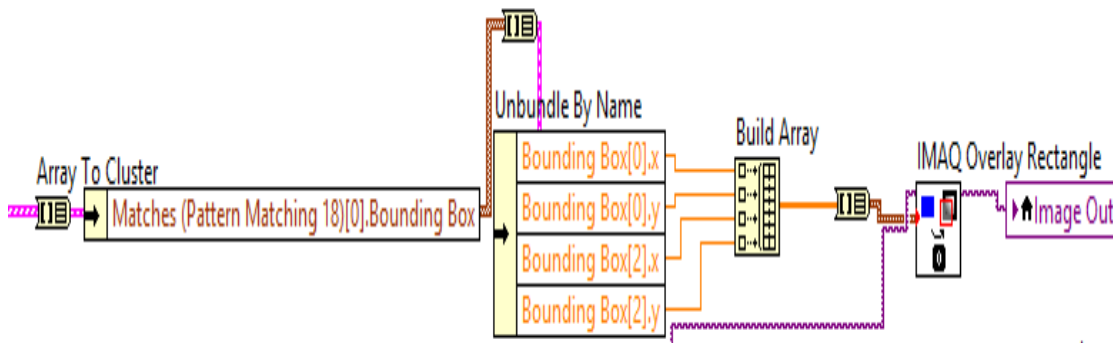
#### 6.4.4.7 To extract data of student from excel sheet

For extracting details like roll no, name a function is used called read from spreadsheet. This function extract the excel sheet in rows and column. After extracting software will decide who is present and who is not. Block diagram for the same is shown in fig. 6.42.



**Figure 6.42:** Block diagram to extract information of student from database

#### 6.4.4.8 Overlay a rectangular box over faces of present student



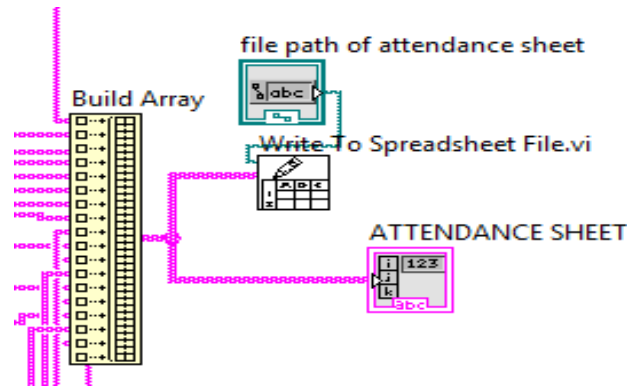
**Figure 6.43:** Block diagram to overlay rectangular box on image

At the location of identified student a rectangular box is overlay on the face as shown in fig. 6.43. For this a function is used called IMAQ overlay rectangular.

#### 6.4.4.9 Append and final result

Finally append the status of each student and save it into excel sheet. For this we use write to spreadsheet function and block diagram in shown in fig. 6.44

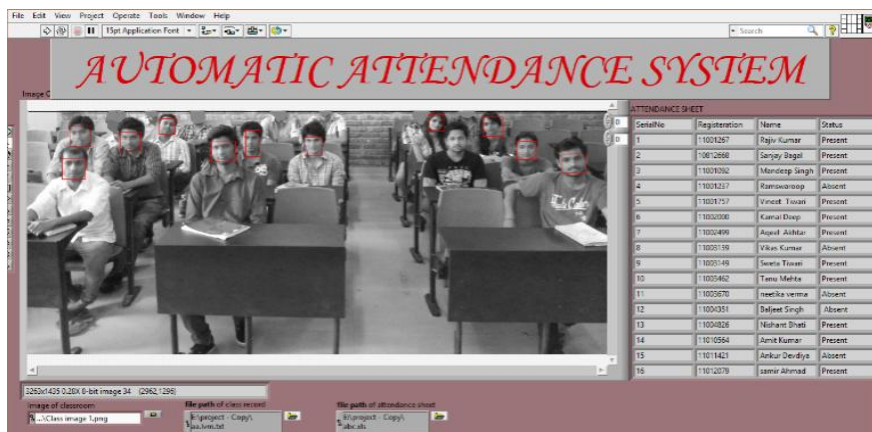




**Figure 6.44:** Block diagram to append the result

### 6.4.4.10 Front panel

Front panel is user interface of LabVIEW [12]. All controls and indicators are present in front panel. In this program front panel consist of Image out, 2-D array, image file input, excels file input and outputs are present as shown in fig. 6.45.



**Figure 6.45:** Front panel of final result

## Conclusions

### 7.1 Conclusion

Advanced Steganography is implemented for security purpose where the objective is to send a message image within a cover image. Advanced security is provided by face recognition. It would be helpful to provide better security in transmission of an image. NI LabVIEW with Motion and Vision toolkit is helpful in implementing the algorithm of steganography.

In order to transmit the encoded image and receive it a transceiver system is implemented. The experimental setup gives the very accurate plots of constellation diagram, eye diagram and bit error rate of different modulation schemes using LabVIEW as software and USRP as hardware, these combination makes the software defined radio. In this project, additive white Gaussian noise (AWGN) channel is used and gave the respective results as shown in the different plots. It may be extended to create real time environment i.e. combination of multipath fading and shadowing fading, which is known as the composite fading. Software defined radio also used in cognitive radio to reduce the traffic of the primary user i.e. licensed user.

Another application of face recognition is implemented which is Automatic Attendance System. Number of modules has been designed and implemented on LabVIEW platform and Image Vision analysis tools in LabVIEW. The objective of automatic attendance system project is to take the students attendance automatically based on face recognition method using NI LabVIEW with Vision toolkit. It would be helpful to reduce the time for taking the attendance and also reduces the manual errors.

### 7.2 Future Scope

The future scope of Steganography is the algorithm can be implemented in text, audio and video transmission. The system which is designed is applicable for any kind of transmission and reception for testing so in future apart from Image Steganography we can also design and transmit other formats.

The future scope of automatic attendance system underlies the hardware implementation with the NI-smart camera being interfaced with the LabVIEW and using the web services of LabVIEW to export the data to the server.

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1. **Amit Kumar**, Srinivas, P. K. Verma, P. R. Chadha, “Automatic Attendance system using Visual Programming Language LabVIEW”, First IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), DTU, Delhi, July 4-6, 2016. (Accepted)
2. **Amit Kumar**, P. K. Verma, “Implementation of Advanced Steganography with Higher Security using LabVIEW”, IEEE India International Conference on Information Processing (IICIP), DTU, Delhi, August 12-14, 2016. (Communicated)
3. P. K. Verma, Sanjay Soni, Priyanka Jain, **Amit Kumar**, “An Experimental study of wireless transceiver of modulation scheme using software defined radio”, First IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), DTU, Delhi, July 4-6, 2016. (Accepted)