Summer Training Report On

ETHERNET BASED TIME CODE READER USING RASPBERRY PI

Submitted By

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CERTIFICATE

This is to certify that this project on "ETHERNET BASED TIME CODE READER USING RASPBERRY PI" submitted by Subhasish Das of Veer Surendra Sai University of Engineering, Department of Electronics and Telecommunication Engineering, 2nd year Engineering student is the outcome of the Training undergone in Timing Division of Integrated Test Range, Chandipur (DRDO) from 20th May to 20th June 2019.

During this period he worked under my guidance and supervision. He has successfully completed the above Projects assigned by me. During his Training, he was sincere and showed keen interest in doing their Projects, thus completing it in stipulated time.

I wish him all success in his future career.

Mr. SoumitraRay
Scientist 'D'
Timing Group

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Scientist 'F'
Group Director (TC & T)

Counter signed by

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ACKNOWLEDGEMENT

In preparing this report, I have received magnificent support from many quarters, which I would like to put on record here with deep gratitude and great pleasure.
First and foremost, I am highly obliged to our internship supervisor, Mr. Soumitra Ray, Sc-D, Timing Group. His expert guidance, encouragement and critical suggestion provided us necessary insight into the research problem and paved the way for the meaningful completion of this report work in a short duration. Without his valuable supervision and guidance, it would have been difficult to complete the whole work in an efficient manner.

I express my warm gratitude and cordial thanks to Mr. C. R. Ojha, Joint Director (HR), Integrated Test Range (ITR), DRDO, Chandipur, Balasore for his guidance and support during my stay in the training period.

I also extend thanks to all other staff & faculty members of DRDO for their direct and indirect support and cooperation.

Subhasish Das
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DEFENCE RESEARCH DEVELOPMENT& ORGANISATION

DRDO works under Department of Defence Research and Development of Ministry of Defence. DRDO is dedicatedly working towards enhancing self-reliance in Defence Systems and undertakes design & development leading to production of world class weapon systems and equipment in accordance with the expressed needs and the qualitative requirements laid down by the three services.
DRDO is working in various areas of military technology which include aeronautics, armaments, combat vehicles, electronics, instrumentation engineering systems, missiles, materials, naval systems, advanced computing, simulation and life sciences. DRDO while striving to meet the Cutting edge weapons technology requirements provides ample spinoff benefits to the society at large thereby contributing to the nation building of India.

Vision

Make India prosperous by establishing world-class science and technology base and provide our Defence Services a decisive edge by equipping them with internationally competitive systems and solutions.

Mission

- Design, develop and lead to production of state-of-the-art sensors, weapon systems, platforms and allied equipment for our Defence Services.
- Provide technological solutions to the Defence Services to optimise combat effectiveness and to promote well-being of the troops.

CONTENTS

PREFACE

This report includes a simple introduction to ITR, then the Timing Division of ITR and descriptions of Global Positioning System (GPS),CDT, ATD, GLOBAL POSITIONING SYSTEM, RASPBERRY PI, UDP PROTOCOL, TKINTER, AND PROJECT PROCEDURE. Every step has been taken to cover the topic exhaustively and present the subject matter in a systematic and lucid style for better understanding of the students. I am very thankful to Mr. SOUMITRA RAY, Scientist-'D' of CENTRAL TIMING DIVISION, ITR, Chandipur, for his generous help of several ways time to time.

I am indebted to our teachers who have provided suggestions to complete the report easily.

INTRODUCTION TO ITR

The Integrated Test Range, sometimes referred to as the Interim Test Range, is a missile testing facility composed of four complexes - Launch Complex-IV (LC-IV) located on Abdul Kalam Island and Launch Complex-I(LC-I),II(LC-II), and III (LC-III) located at Chandipur.

The India government began searching for a suitable location to construct a dedicated military missile test range and begin development of the Agno series of missiles in the early 1980s. The DRDO constructed an interim facility adjacent to the Proof and Experimental Establishment (PXE) at Chandipur. In 1986, the Union Government announced plans to construct a National Test Range at Baliapal in Balasore district, the same district as Chandipur.

The Integrated Test Range (ITR) is an Indian defense laboratory of Defense Research & Development Organization (DRDO). Its main purpose is to provide safe and reliable launch facilities as well as project and user specified data for performance evaluation of rockets flight vehicles and air-borne weapon systems by meeting all applicable statutory and regulatory requirements. It also works towards continual improvement of quality management system for enhancing customer satisfaction.

ITR is mainly used for launching missiles, rockets and flight test vehicles, a dedicated range known as Integrated Test Range (ITR) was established in 1989 at Chandipur, 15 km from Balasore, Orissa. A number of test vehicles of different class including multirole missile likeTrishul, multi target capability missile like Akash, the anti tank Nag missile, the most precise surface-to-surface missile Prithvi and the Agni-I large scale technology demonstrator have been test fired from this range. With its versatile technical and scientific capability, ITR has also supported a number of other missions such as Multi barrel Rocket Launcher—Pinaka and Pilotless Target Aircraft (PTA).
The range is spread over a length of 17 km along the sea coast where a number of tracking instruments have been deployed to cover the total flight path of the test vehicles.

FACILITIES

- Electro-Optical Tracking System (Mobile and Fixed)
- S-Band Tracking Radar (KAMA-N) (Mobile)
- C-Band Tracking Radar (PCMC) (Fixed)
- Telemetry System (Fixed and Mobile)
- Range Computer
- Timing
- Communication
- CCTV System
- Photo Processing System
- Meteorological System
- Range Safety System

TIMING DIVISION

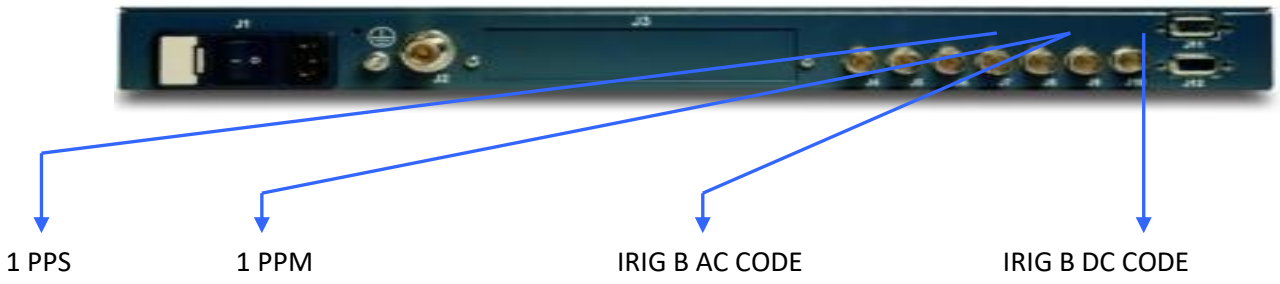
ITR, Chandipur is having various departments for carrying out different tests which are helpful for military purposes. Of these various departments, our project was carried out in Timing division. In this division there are GPS receivers which receive signals from the different satellites launched in their respective orbit. Signal containing Ephemeris, Telemetry, Health status, Almanac, Timing are received from the satellites by the GPS Receiver. These signals are processed to extract position and time information. Time code used in ITR is of the format of IRIG-B [Days: Hours: Minutes: Seconds]. In this department, we have gone through GPS receivers and other Timing devices which include Program Clock, Switching Unit and Distribution System, Hold unit, Time Code Reader, PTP Server, NTP Server, UTCG, 56k, etc.

Objectives of Timing Division:

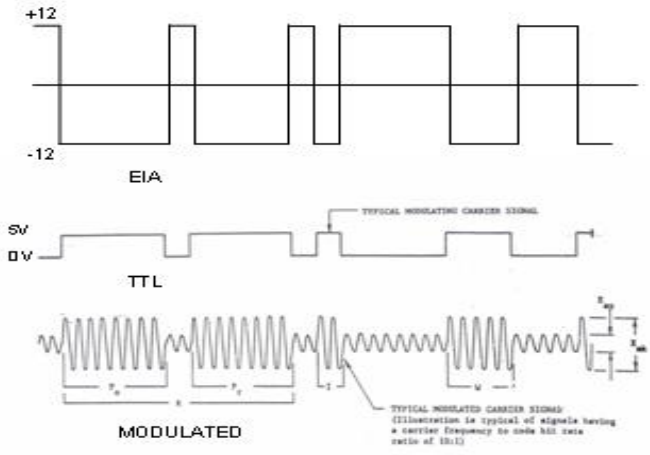
- Acquisition of Real Time (ATD) through GPS receiver & distribution to sensors for synchronization.
- Generation & Distribution of Count down Time to all stations**.**

Major Systems used in Timing Division:

- GPS Receiver
- Program Clock
- Distribution Network
- Time Code Reader
- Hold Services Unit (RTD)

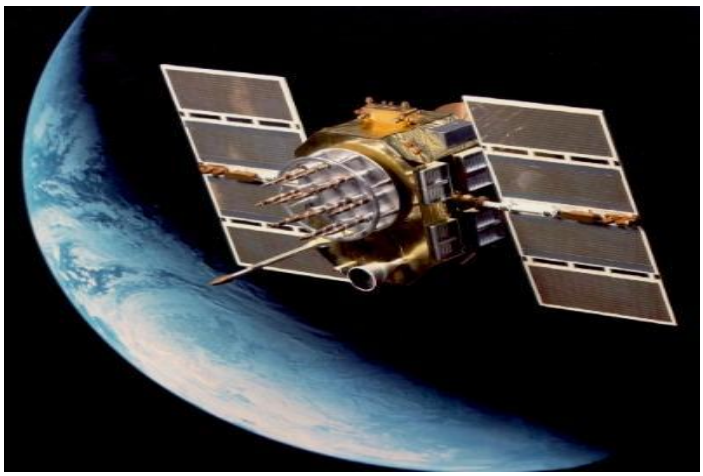


EIA, TTL & MOD CODE FOR TIMING SIGNAL



GLOBAL POSITIONING SYSTEM(GPS)

INTRODUCTION TO GPS:

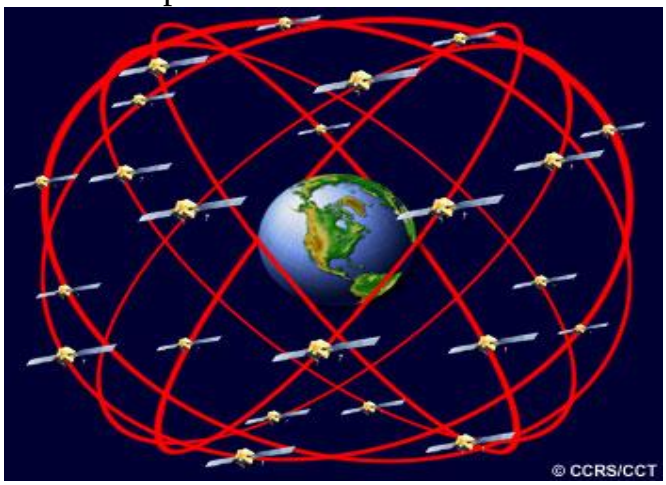


The Global Positioning System (GPS) is a satellite-based navigation system that consists of 24 orbiting satellites, each of which makes two circuits around the Earth every 24 hours. These satellites transmit three bits of information – the satellite's number, its position in space, and the time the information is sent. These signals are picked up by the GPS receiver, which uses this information to calculate the distance between it and the GPS satellites.

HOW IT WORKS :

The Global Positioning System (GPS) is a network of about 30 satellites orbiting the Earth at an altitude of 20,000 km. The system was originally developed by the US government for military navigation but now anyone with a GPS device, be it a SatNav, mobile phone or handheld GPS unit, can receive the radio signals that the satellites broadcast.

Wherever you are on the planet, at least four GPS satellites are 'visible' at any time. Each one transmits information about its position and the current time at regular intervals. These signals, travelling at the speed of light, are intercepted by your GPS receiver, which calculates how far away each satellite is based on how long it took for the messages to arrive.



Once it has information on how far away at least three satellites are, your GPS receiver can pinpoint your location using a process called trilateration.

GPS RECIEVERS:

A GPS Receiver is an L-band radio processor capable of solving the navigation equation in order to determine the user position, velocity and precise time (PVT), by processing the signal broadcasted by GPS satellites.

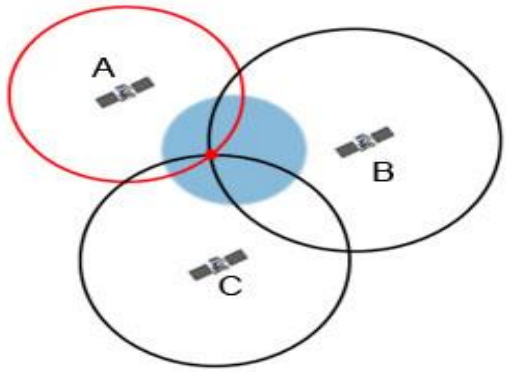
Any navigation solution provided by a GNSS Receiver is based on the computation of its distance to a set of satellites, by means of extracting the propagation time of the incoming signals travelling through space at the speed of light, according to the satellite and receiver local clocks.

Notice that satellites are always in motion, so previous to obtaining the navigation message, the satellite's signal is detected and tracked. The receiver's functional blocks that perform these tasks are the antenna, the front-end and the baseband signal processing (in charge of acquiring and tracking the signal).

Once the signal is acquired and tracked, the receiver application decodes the navigation message and estimates the user position.

USE OF GPS:

GPS systems are extremely versatile and can be found in almost any industry sector. They can be used to map forests, help farmers harvest their fields, and navigate airplanes on the ground or in the air.**GPS** systems are used in military applications and by emergency crews to locate people in need of assistance.



Dissemination:

Dissemination takes on the theory of the traditional view of communication, which involves a sender and receiver. The traditional communication view point is broken down into a sender sending information, and receiver collecting the information processing it and sending information back, like a telephone line.

IRIG-B:

IRIG-B refers to a serial **time** code format. This a timing signal that has a rate of 100 pulse per second signal, There are other rate that are designated in accordance with the **IRIG** Standard 200-04 (see below). **IRIG-B** sends Day of Year, Hour, Minute and Second data on a 1 KHz carrier, with an update rate of one second.

Cu-Cable:

Ethernet **uses** physical **wiring** (**copper** and optical fiber **cables**) to connect devices and, frequently, deployed devices include: hubs, switches, bridges and/or routers. Wireless LAN technology is designed to connect devices without **wiring**. These devices **use** radio waves or infrared signals as a transmission medium.

Master-Slave :

Master/slave is a model of communication where one device or process has unidirectional control over one or more other devices. In some systems a master is selected from a group of eligible devices, with the other devices acting in the role of slaves.

In the context of motor control, the master/slave configuration is used for load sharing purposes when two identical motors connected to two different drives are coupled to a common load. One drive is defined as the master and is configured for running in the speed-control mode whereas the other defined as slave is configured for running in torque-control mode

Client-Server:

A computer **network** in which one centralized, powerful computer (called the **server**) is a hub to which many less powerful personal computers or workstations (called **clients**) are connected. The **clients** run programs and access data that are stored on the **server**. Compare peer-to-peer **network** .

ETHERNET:

Ethernet is a family of computer networking technologies commonly used in local area networks (LAN), metropolitan area network (MAN) and wide area networks (WAN).
Ethernet has been refined to support higher bit rates and longer link distances.
Over time, Ethernet has largely replaced competing wired LAN technologies.

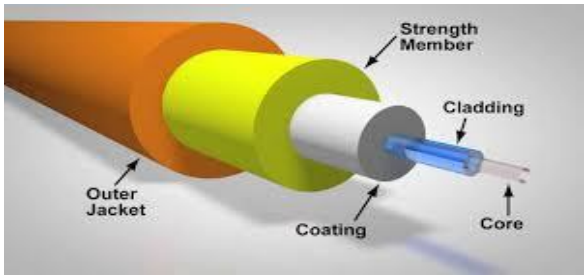
NTP:

Network Time Protocol (NTP) is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks.
NTP is one of the oldest Internet protocols in current use.
NTP is intended to synchronize all participating computers to within a few milliseconds. NTP can usually maintain time to within tens of milliseconds over the public Internet, and can achieve better than one millisecond accuracy in local area networks under ideal conditions.

PTP:

The Precision Time Protocol (PTP) is a protocol used to synchronize clocks throughout a computer network. On a local area network, it achieves clock accuracy in the sub-microsecond range, making it suitable for measurement and control systems.

OPTICAL FIBRE:



An optical fibre is a flexible, transparent fibre made by drawing glass (silica) or plastic to a diameter slightly thicker than that of a human hair. Optical fibres are used most often as a means to transmit light between the two ends of the fibre and find wide usage in fibre-optic communications, where they permit transmission over longer distances and at higher bandwidths (data rates) than electrical cables. Fibres are used instead of metal wires because signals travel along them with less loss; in addition, fibres are immune to electromagnetic interference, a problem from which metal wires suffer excessively. Multi-mode fibres generally have a wider core diameter and are used for short-distance communication links and for applications where high power must be transmitted. Single-mode fibres are used for most communication links longer than 1,000 meters (3,300 ft).

ATD SYSTEM

ATD stands for Accumulated Time of Days. It is the real time. ATD always counts in UP direction. We cannot stop it .It regulates and works by synchronizing with GPS.

Accumulated time means the time worked in excess of ordinary hours in any day and within the daily spread of hours.

OSCILLATORS

An *oscillator* is a circuit which produces a continuous, repeated, alternating waveform without any input.

A **crystal oscillator** is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators but other piezoelectric materials including polycrystalline ceramics are used in similar circuits.

Atomic clock can be made up of using Cesium, Rubidium, OCXO, & TCXO

Rubidium and **Cesium** are the two elements that can be used in timing sector because of its accuracy. But Cesium is not used commonly because of its high price. Cesium accuracy is very high as compared to other elements it only changes 1 second in a period of 100 years. Rubidium is also very accurate so we can replace it in place of Cesium. Its price is less as compared to Cesium.

TCXO & OCXO

The oscillation frequency of a crystal changes as temperature varies. Both **TCXOs (Temperature Compensated Crystal Oscillators)** and **OCXOs (Oven Controlled Crystal Oscillators)** are crystal oscillators who oscillation frequency does not vary as much at high temperatures or when the temperature fluctuates.

Design: A TCXO uses a compensation circuit to counter/compensate for the change in output frequency due to temperature variation.

In an OCXO, the crystal oscillator is placed in an oven that is pre-heated to a higher temperature. This way an external temperature variation will not impact the output frequency of the oscillator. Due to the fact that OCXO's use an oven, they usually bulky and require some time to heat the oven before providing the frequency stability vs temperature variation. They also have higher power requirements as compared to TCXO's as the oven requires a supply voltage to maintain a higher temperature.

Cost: The cost of an OCXO is significantly higher than a TCXO as the OCXO has more components - mainly the oven and circuitry required to heat the oven

.

ACCURACY LEVEL:

Cesium > Rubidium > OCXO > TCXO

CDT SYSTEM

A countdown is a sequence of backward counting to indicate the time remaining before an event is scheduled to occur. It is user defined and can also be paused when needed i.e. we can hold the CDT when needed .

Other events for which countdowns are commonly used include the detonation of an explosive, the start of a race, the start of the New Year or any anxiously anticipated event. A countdown is a carefully devised set of procedures ending with the ignition of a rocket's engine.

PROGRAM CLOCK

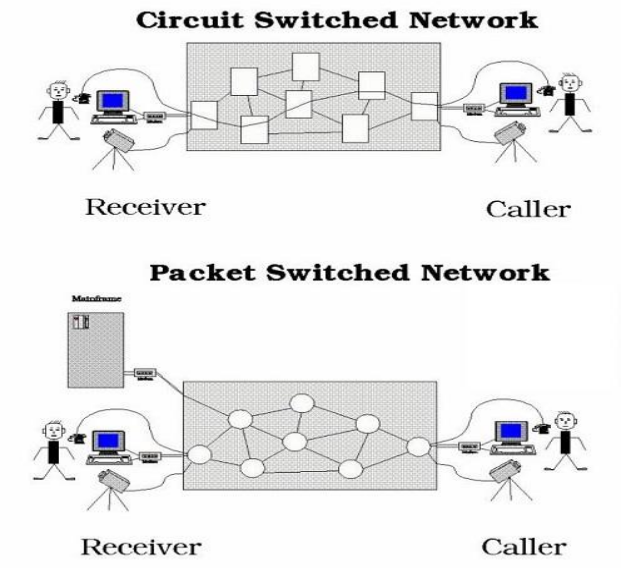
Distribution Methodologies:

A server is a computer program or device that provides a service to another computer program and its user, also known as the client. In a data center, the physical computer that a server program runs on is also frequently referred to as a server. That machine may be a dedicated server or it may be used for other purposes as well.

Time Code Reader-Time and Control Code, more commonly called Timecode, is a video synchronising standard which is based on a 24-hour clock readout. Each frame of vision is given a unique Timecode reading. Apparatus to display this reading is known as the Time Code Reader

Circuit Switched Network

Circuit switching requires a dedicated physical connection between the sending and receiving devices. For example, parties involved in a phone call have a dedicated link between them for the duration of the conversation. When either party disconnects, the circuit is broken, and the data path is lost. This is an accurate representation of how circuit switching works with network and data transmissions. The sending system establishes a physical connection, and the data is transmitted between the two. When the transmission is complete, the



channel is closed.

Packet Switched Network
In packet switching, messages are broken into smaller pieces called packets. Each packet is assigned source and destination addresses. Packets are required to have this information because they do not always use the same path or route to get to their intended destination. Packets can take an alternative route if a particular route is unavailable for some reason.

IP-An **Internet Protocol address** (**IP address**) is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication. An IP address serves two principal functions: host or network interface identification and location addressing.

Port-In computer **networking**, a **port** is an endpoint of communication. Physical as well as wireless connections are terminated at **ports** of hardware devices. At the software level, within an operating system, a **port** is a logical construct that identifies a specific process or a type of **network** service.

Mac Address-It stands for "Media Access Control Address," and no, it is not related Apple Macintosh computers. A MAC address is a hardware identification number that uniquely identifies each device on a network. The MAC address is manufactured into every network card, such as an Ethernet card or Wi-Fi card, and therefore cannot be changed.

Hub-A hub, also called a network hub, is a common connection point for devices in a network. Hubs are devices commonly used to connect segments of a LAN. The hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

Switch-A **network switch** (also called **switching hub**, **bridging hub**, officially **MAC bridge**) is a computer networking device that connects devices on a computer network by using packet switching to receive, process, and forward data to the destination device.

Router-A **router** is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet. A router is connected to two or more data lines from different networks. When a data packet comes in on one of the lines, the router reads the network address information in the packet to determine the ultimate destination.

RASPBERRY PI: AN INTRODUCTION

Board	Raspberry Pi 2 Model B	**Raspberry Pi 3 Model B**
Processor	Broadcom BCM2836	Broadcom **BCM2837**
CPU Core	Quadcore ARM Cortex-A7, 32Bit	Quadcore **ARM Cortex-A53, 64Bit**
Clock Speed	900 MHz	1.2GHz (Roughly 50% faster than Pi2)
RAM	1 GB	1 GB
GPU	250 MHz VideoCore IV®	**400 MHz** VideoCore IV®
Network Connectivity	1 x 10 / 100 Ethernet (RJ45 Port)	1 x 10 / 100 Ethernet (RJ45 Port)
Wireless Connectivity	None	**802.11n wireless LAN (WiFi) and Bluetooth 4.1**
USB Ports	4 x USB 2.0	4 x USB 2.0
GPIOs	2 x 20 Pin Header	2 x 20 Pin Header
Camera Interface	15-pin MIPI	15-pin MIPI
Display Interface	DSI 15 Pin / HDMI Out / Composite RCA	DSI 15 Pin / HDMI Out / Composite RCA
Power Supply (Current Capacity)	1.8 A	**2.5 A**

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards and mice) and cases. However, some accessories have been included in several official and unofficial bundles. The organisation behind the Raspberry Pi consists of two arms. The first two models were developed by the Raspberry Pi Foundation. After the Pi Model B was released, the Foundation set up Raspberry Pi Trading, with Eben Upton as CEO, to develop the third model, the B+. Raspberry Pi Trading is responsible for developing the technology while the Foundation is an educational charity to promote the teaching of basic computer science in schools and in developing countries.

According to the Raspberry Pi Foundation, more than 5 million Raspberry Pis were sold by February 2015, making it the best-selling British computer. By November 2016 they had sold 11 million units, and 12.5m by March 2017, making it the third best-selling "general purpose computer". In July 2017, sales reached nearly 15 million. In March 2018, sales reached 19 million. Most Pis are made in a Sony factory in Pencoed, Wales; some are made in China or Japan.

UDP COMMUNICATION PROTOCOL

In computer networking, the User Datagram Protocol (UDP) is one of the core members of the Internet protocol suite. The protocol was designed by David P. Reed in 1980 and formally defined in RFC 768. With UDP, computer applications can send messages, in this case referred to as datagrams, to other hosts on an Internet Protocol (IP) network. Prior communications are not required in order to set up communication channels or data paths.UDP uses a simple connectionless communication model with a minimum of protocol mechanisms. UDP provides checksums for data integrity, and port numbers for addressing different functions at the source and destination of the datagram. It has no handshaking dialogues, and thus exposes the user's program to any unreliability of the underlying network; there is no guarantee of delivery, ordering, or duplicate protection. If error-correction facilities are needed at the network interface level, an application may use Transmission Control Protocol (TCP) or Stream Control Transmission Protocol (SCTP) which are designed for this purpose.

UDP is suitable for purposes where error checking and correction are either not necessary or are performed in the application; UDP avoids the overhead of such processing in the protocol stack. Time-sensitive applications often use UDP because dropping packets is preferable to waiting for packets delayed due to retransmission, which may not be an option in a real-time system.

A number of UDP's attributes make it especially suited for certain applications.

- It is transaction-oriented, suitable for simple query-response protocols such as the Domain Name System or the Network Time Protocol.
- It provides datagrams, suitable for modeling other protocols such as IP tunneling or remote procedure call and the Network File System.
- It is simple, suitable for bootstrapping or other purposes without a full protocol stack, such as the DHCP and Trivial File Transfer Protocol.
- It is stateless, suitable for very large numbers of clients, such as in streaming media applications such as IPTV.
- Because it supports multicast, it is suitable for broadcast information such as in many kinds of service discovery and shared information such as Precision Time Protocol and Routing Information Protocol.

TKINTER

Tkinter is a Python binding to the Tk GUI toolkit. It is the standard Python interface to the Tk GUI toolkit, and is Python's de facto standard GUI. Tkinter is included with standard Linux, Microsoft Windows and Mac OS X installs of Python.The name Tkinter comes from Tk interface. Tkinter was written by Fredrik Lundh. Tkinter is free software released under a Python license.

As with most other modern Tk bindings, Tkinter is implemented as a Python wrapper around a complete Tcl interpreter embedded in the Python interpreter. Tkinter calls are translated into Tcl commands which are fed to this embedded interpreter, thus making it possible to mix Python and Tcl in a single application.Python 2.7 and Python 3.1 incorporate the "themed Tk" ("ttk") functionality of Tk 8.5. This allows Tk widgets to be easily themed to look like the native desktop environment in which the application is running, thereby addressing a long-standing criticism of Tk (and hence of Tkinter).

There are several popular GUI library alternatives available, such as wxPython, PyQt (PySide), Pygame, Pyglet, and PyGTK.

Some definitions:

Window: This term has different meanings in different contexts, but in general it refers to a rectangular area somewhere on the user's display screen.

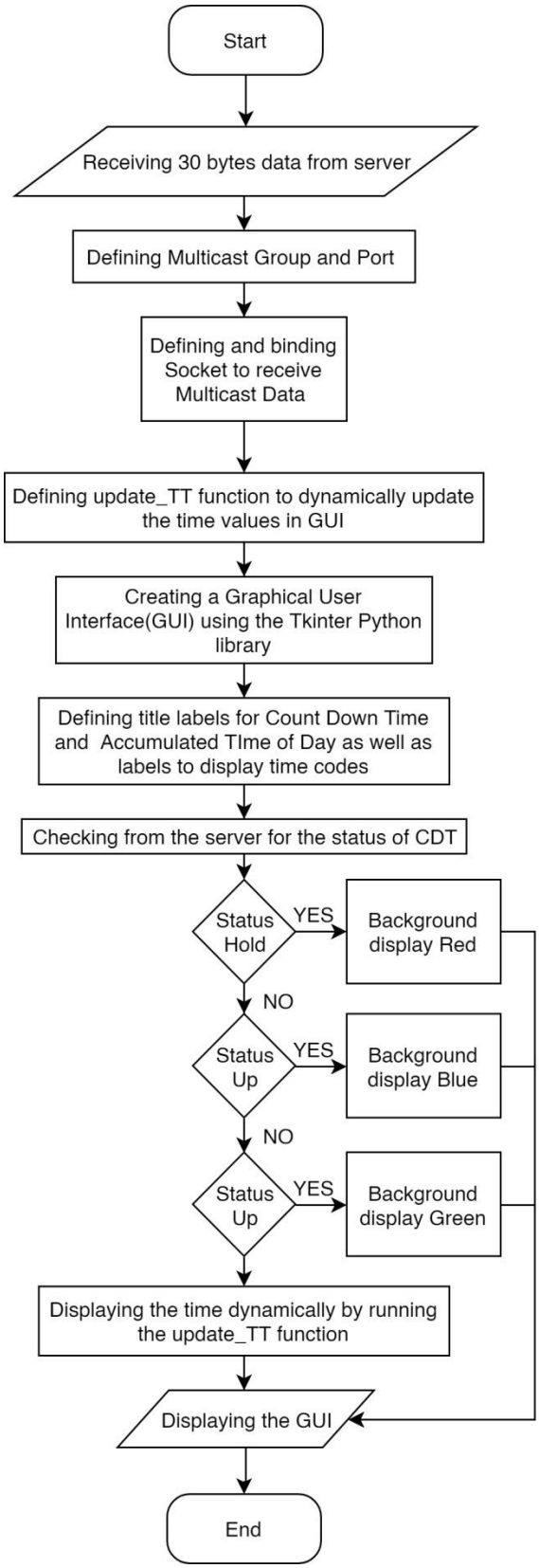
Top Level Window: A window that exists independently on the screen. It will be decorated with the standard frame and controls for the desktop manager. It can be moved around the desktop, and can usually be resized.

Widget: The generic term for any of the building blocks that make up an application in a graphical user interface.

Frame: In Tkinter, the Frame widget is the basic unit of organization for complex layouts. A frame is a rectangular area that can contain other widgets.

Child and parent: When any widget is created, a parent-child relationship is created. For example, if you place a text label inside a frame, the frame is the parent of the label.

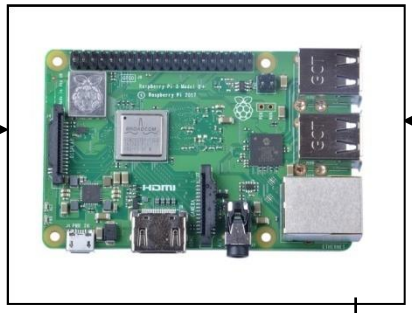
ALGORITHM


Start
Receiving 30 bytes data from server
Defining Multicast Group and Port
Defining and binding Socket to receive Multicast Data
Defining update_TT function to dynamically update the time values in GUI
Creating a Graphical User Interface(GUI) using the Tkinter Python library
Defining title labels for Count Down Time and Accumulated TIme of Day as well as labels to display time codes
Checking from the server for the status of CDT
Status Hold
YES
Background display Red
NO
Status Up
YES
Background display Blue
NO
Status Up
YES
Background display Green
Displaying the time dynamically by running the update_TT function
Displaying the GUI
End

BLOCK DIAGRAM

ITR TIMING SERVER

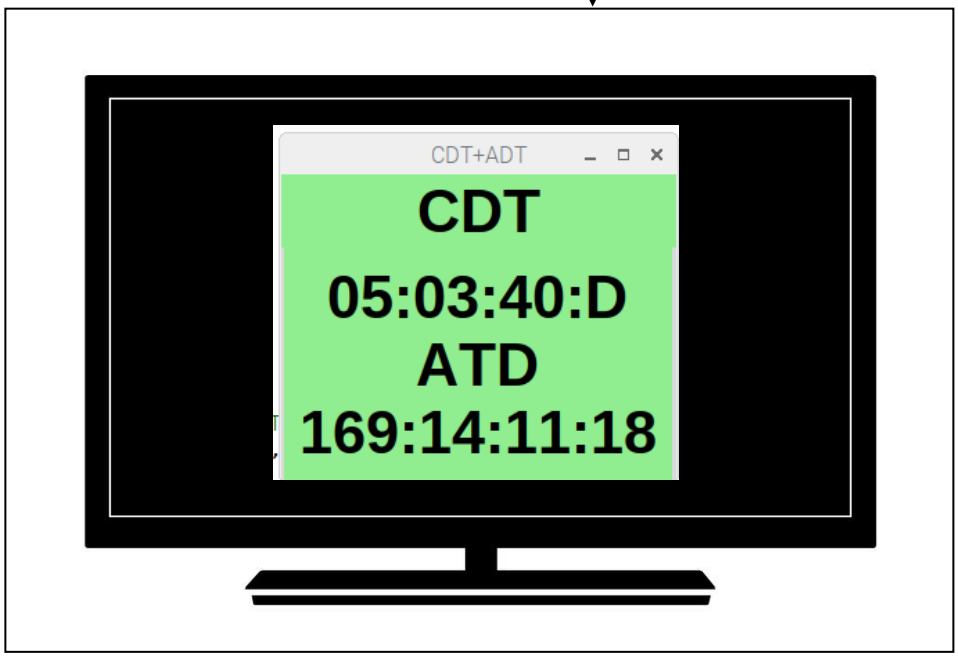
ETHERNET



RASPBERRY PI 3B

INPUT PERIPHERALS

HDMI



OUTPUT LCD DISPLAY

PROJECT PROCEDURE

Problem Statement: An Ethernet Based Time Code Reader using Raspberry Pi

The problem statement was for the Raspberry Pi to UDP read Multicast data supplied via the Ethernet port from the timing server. 10 of those bytes consist of the CDT data while the rest 12 consist of ATD data. It required the use of Python libraries struct, socket, and tkinter. The project was done in multicast system, and the display was programmed to change colors, depending upon the state of the CDT: Up, Down, Hold being the three states, represented by U, D, and H respectively

Resources Used:

- Raspberry Pi 3B
- Ethernet Cable
- HDMI Cable
- Samsung OLED TV Display

Project Code:

```
import socket
import struct
import tkinter as tk
MCAST_GRP = '234.5.6.7'
MCAST_PORT = 58432
#Multicast communication setup
sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM,
socket.IPPROTO_UDP)
sock.setsockopt(socket.SOL_SOCKET, socket.SO_REUSEADDR, 1)
sock.bind(('', MCAST_PORT))
mreq = struct.pack("4sl", socket.inet_aton(MCAST_GRP),
socket.INADDR_ANY)
sock.setsockopt(socket.IPPROTO_IP, socket.IP_ADD_MEMBERSHIP, mreq)

#Time update function to be called in the GUI
def update_TT():
    current1 = sock.recvfrom(30)
    current = (current1[0])
    TT.configure(text=current)
    root.after(100,update_TT)
```

```
#GUI using Tkinter
root = tk.Tk()
root.wm_title("CDT+ADT")
data = sock.recvfrom(30)
x='white'
status=data[0]
#root.after(100,update_data)
if status=='H':
    x='yellow'
if status=='U':
    x='lightgreen'
if status=='D':
    x='lightblue'
else:
    x='purple'
tk.Label(root, text = "        CDT        ", bg=x, fg = "black", font = "Helvetica 32
bold").pack()
TT = tk.Label(root, text="", bg=x,fg='black',bd='10',height='3',font="Helvetica 32
bold")
TT.pack()
update_TT()
root.mainloop()
```

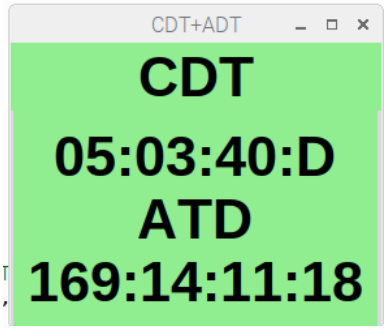
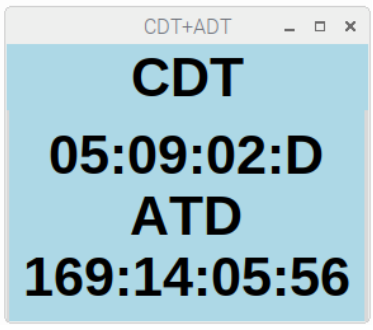
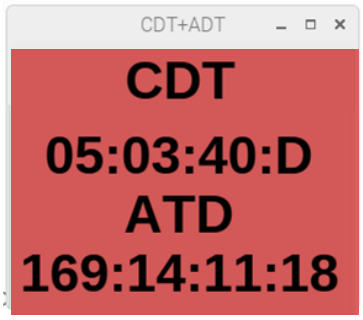
		
Down counter - Green	Up counter - Blue	Hold - Red

Fig. Demonstration of colors for various countdown modes of CDT

CONCLUSION AND FUTURE SCOPE OF WORK

In this project, we have designed, constructed, and programmed a Time Code Reader using affordable hardware and a microprocessor that is commonly available on the market i.e. Raspberry Pi 3B. The Time Code reader can dynamically update its GUI in order to display the Countdown Timer as well as ATD which is supplied from the Timing server. It is an essential part of Mission Control and Coordination and helps in successful synchronisation of the mission activities.

This highly portable, durable, and affordable Time Code Reader can be accessed remotely via appropriate applications such as VNC Viewer allowing us to access the timer with microsecond level accuracy from anywhere in the range network.

This setup is also vastly superior to mechanical timers. Mechanical timers are not as precise and clear. They carry the risk of being jammed. Mechanical timers also lack the level of customization and responsiveness of apparatus such as the one described in this report, making them a vastly superior alternative and the way forward in the realm of Timing in Mission Control and Coordination.

Future scope of work in this project includes the complete fabrication of the Raspberry Pi and LCD screen setup along with the output peripherals such as Ethernet, USB, HDMI, etc thereby creating a completely portable Timing device fit for use in a mission scenario.

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