Report of Internship Training

at

EWARN SYSTEMS PVT LTD

Submitted by

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B Tech. Electronics and Communications Engineering

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. **H Ranga Nirmana Perera** a student of National Institute of Technology, Rourkela has successfully completed his internship under my guidance. He worked on "**Auto-Tracking System for FSO Communication**" from 4th May 2021 to 21st August 2021.

During his tenure with us, I found him sincere, hardworking and honest. We wish him all the best for his future endeavours.

Signature of the HR Representative

Summer Internship 2021 - Final Report

H.Ranga N. Perera - 118EC0612 ($B.Tech.ElectronicsandCommunicationsEngineering$)

***Abstract*— This paper describes my first Industrial experience in Electronics and Communications Engineering domain.In this I have worked on designing an Auto tracking system for FSO(Free Space Optical) communication.For successful transmission of optical signals, FSO communication systems use free space as a communication channel between transceivers that are line-of-sight (LOS).The channel can be atmosphere, space, or vacuum, whose characteristics determine the transmission and reception of optical signals for designing reliable and efficient communication systems.In this intern period I have studied about FSO communication system,Worked on designing an Auto tracking system for FSO Communication and further desingned an Application interface for the Auto tracking system.**

I. INTRODUCTION

This document consists of my learning experiences,work I have done during the intern period. I worked in EWARN SYSTEMS PVT LTD and My mentor was Mr.Vinod Kiran sir, Ph. D, from the Dept. of Electronics and Communications Engineering at the National Institute of Technology, Rourkela.He directed me throughout the Intern period and assigned me the tasks. The first task given by him was to study Free-space optical communication and to get a good understanding of the area. He provided me with the relevant materials to go through and I was also asked to find more myself about the FSO communications systems.Then I was asked to study the Auto tracking system and to do a stability analysis of the system. My third task was to rotate the Auto tracking system manually to a given angle using Arduino. And then finally I was asked to design a mobile application to detect the angles and deviations from the original position. The tasks I have worked on are explained in the below sections.

II. FREE SPACE OPTICAL COMMUNICATION

A. Free Space Optical Communication Background

FSO communication systems are where free space acts as a communication channel between transceivers that are line-of-sight (LOS) for successful transmission of optical signals. The channel, which might be atmosphere, space, or vacuum, determines how optical signals are transmitted and received, allowing for the development of dependable and efficient communication systems. Data is transmitted using FSO technology via light propagation over atmospheric or space communication routes, allowing optical connectivity.FSO communication provides a high data rate in order to fulfil the rapidly growing demand for broadband traffic, which is primarily driven by Internet access and HDTV broadcasting services. FSO allows far more freedom in creating optical network designs at very high speeds, at tens and hundreds of

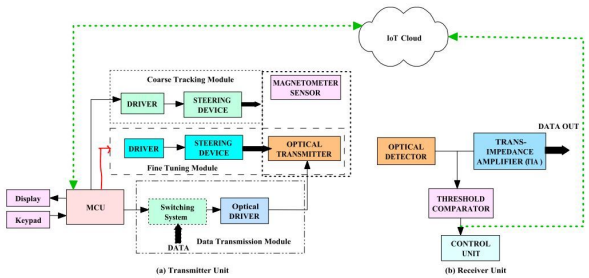

Fig. 1.

Gbit/s rates, when compared to fibre optics technology.Both point-to-point, point-to-multipoint, multipoint-to-point, and multipoint-to-multipoint FSO communications are possible, depending on the different scenarios of establishing optical links.

B. Applications of FSO Systems

- Telecommunication and computer networking
- Point-to-point LOS links
- Temporary network installation for events or other purpose as disaster recovery
- For communications between spacecraft, including elements of satellite constellation
- Security applications
- Military application
- Metro network extensions
- Enterprise connectivity
- Fiber backup

III. STABILITY ANALYSIS OF THE AUTO TRACKING SYSTEM

This system is an antenna position control system which rotates antenna at certain angle for effective communication.Here we have analysed each of the componenets of the system first and obtained the transfer function of each components .Then obtained the overall transfer function of the system and analysed the stability of the system. Block diagram of the Auto tracking system for FSO Communication is given above(Fig 1).The team have already worked on the system designing and the figures of the system is given below(Fig2).

IV. AUTO TRACKING SYSTEM DESIGN:

Then I was asked to study about the interfacing of magnetometer to Arduino, Stepper motor to arduino , Esp32 to arduino and sending data to firebase. After going through those I was asked to roate the system to a given angle and I was able to complete the task succesfully. Some of the connection diagrams are given below.

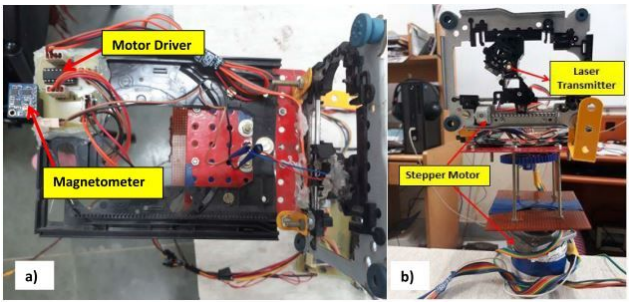

Fig. 2.

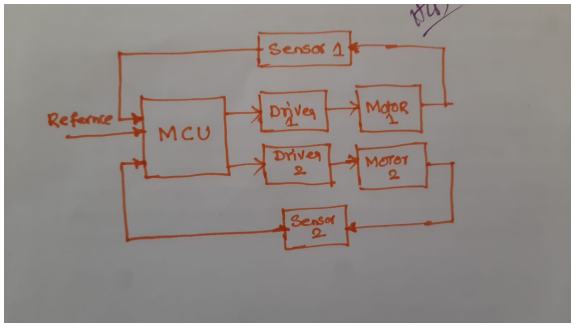

Fig. 3.

V. Mobile Application Design :

Then I designed a Mobile application to the system. The application basically consists of three main inputs, which are the angle between each positions where the transmitter and receiver stands.There are three basic locations and the deviation from the original position is given as an Input to the system. Then the system outputs the degree of Miss allignment and whether the system is fine tunning initiated. The inputs are given to the firebase and then the required calculations are done.(Fig4, Fig5 , Fig6)

VI. CONCLUSIONS

It was a great opportunity for me to work in Ewarn Systems Pvt.Ltd in my summer intern period. I got the opportunity to get the hands on experience on various projects and learnt how to go deep into a project step by step from the begining. Here I was able to learn the technologies such as free space optical communication and further able to practically work with the newest compononts and to implement the work under the guidence of my mentor. Further I will be attaching some of the work related diagrams in the nec=xt page for referecnce.

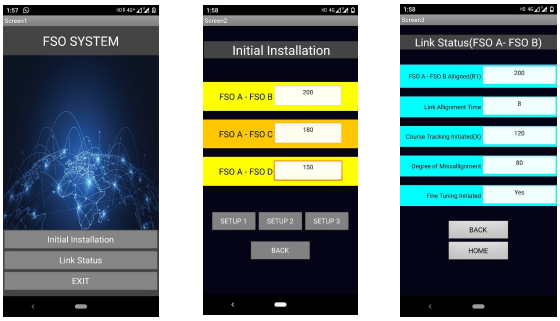

Fig. 4.

Fig. 5.

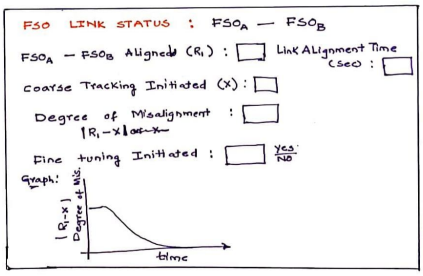

Fig. 6.

ACKNOWLEDGMENT

I would like to thank , EWARN SYSTEMS Pvt.Ltd for giving me this valuable opportunity to do my summer internship and to Mr. Vinod Kiran sir, P.h.d NIT Rourkela for guiding me through out the intern period.

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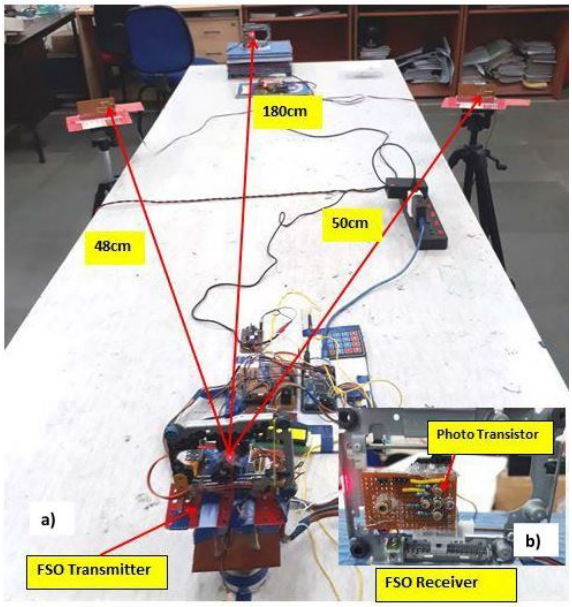
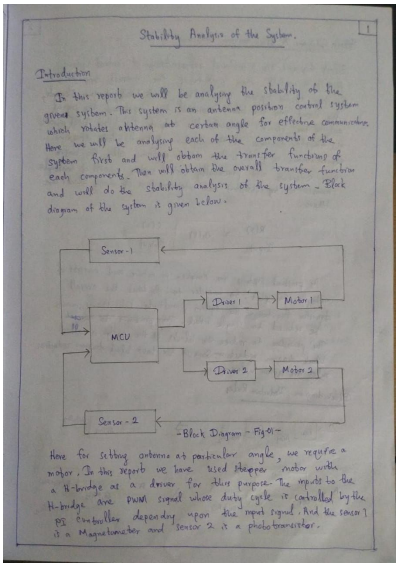




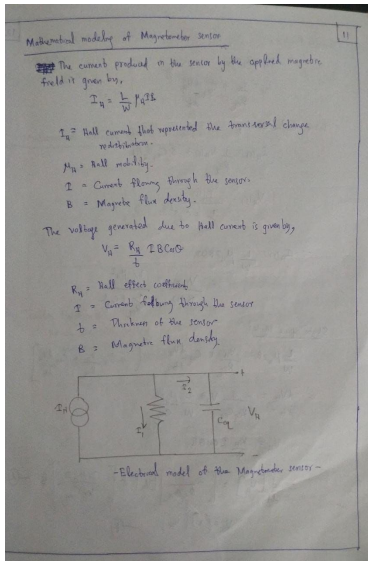
Stability Analysis of the System.

Introduction

In this report we will be analyzing the stability of the given system. The system is an antenna position control system which rotates antenna at certain angle for effective communication. Here we will be analyzing each of the components of the system first and will obtain their transfer functions of each components. Then will obtain the overall transfer function and will do the stability analysis of the system. Block diagram of the system is given below.

-Block Diagram - Fig 01-

Here for sitting antenna at particular angle, we require a motor. In this report we have used stepper motor with a H-bridge as a driver for this purpose. The inputs to the H-bridge are PWM signal whose duty cycle is controlled by the PIC controller depending upon the input signal. And the sensor 1 is a Magnetometer and sensor 2 is a phototransistor.



Mathematical modeling of Magnetometer sensor

The current produced in the sensor by the applied magnetic field is given by,

$$I_H = \frac{1}{W} R_H I B$$

I_H = Hall current that represented the transversal charge redistribution.

R_H = Hall mobility.

I = Current flowing through the sensor.

B = Magnetic flux density.

The voltage generated due to Hall current is given by,

$$V_H = \frac{R_H}{b} I B \cos\theta$$

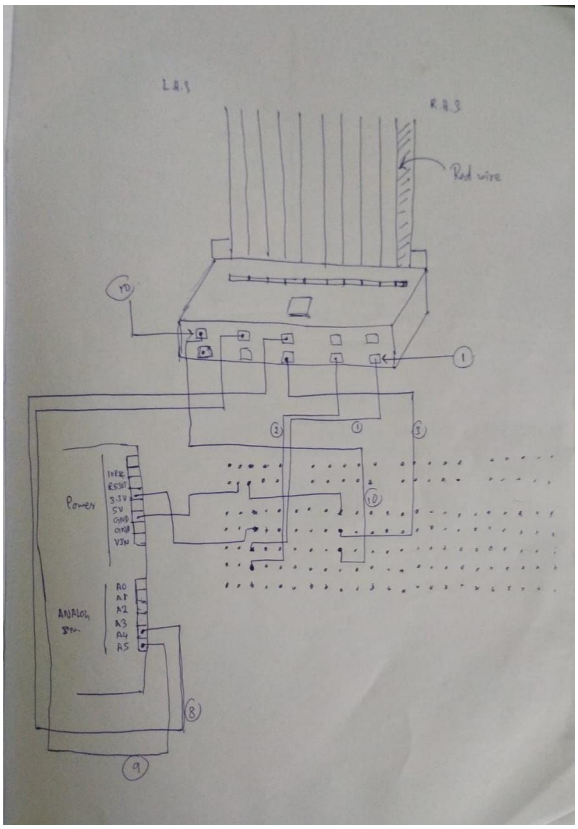
R_H = Hall effect coefficient

I = Current flowing through the sensor

b = Thickness of the sensor

B = Magnetic flux density

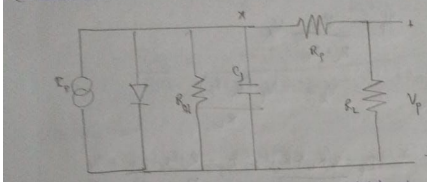
-Electrical model of the Magnetometer sensor-



Comparing (4) with $\dot{x} = Ax + Bu$ and equation (5) with $y = Cx + Du$ we get,

$$A = \left[\frac{-1}{R_H C_H}\right] \quad B = \left[\frac{I_H R}{W C_H}\right] \quad C = [1] \quad D = [0]$$

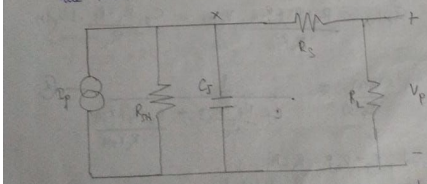
Mathematical modelling of phototransistor



-Equivalent electrical model of phototransistor-

Transfer function:

As we use CB junction in reverse bias most of the time, we can remove the diode from the equivalent circuit model. So, the model reduces to the model given below.



-Equivalent electrical model when CB junction is in reverse bias-