Faculty of Information Technology

Automated Camera Stand

Group 47

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Date of Submission: 08/06/2022

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Introduction

Wildlife photography is a popular category of photography, done by beginners, enthusiasts, and professionals. When taken technically, it involves capturing any type of animal, from birds to insects to butterflies to mammals. But wildlife photographers most commonly take photos of mammals, reptiles, amphibians, and birds. Wildlife photography is a loosely defined profession that demands a passion for nature and art. These photographers make a career of traveling to remote areas and taking pictures of wild animals and natural scenery with a risk.[01]

Wildlife photographers are some of the world's most valued professionals. According to the U.S. Bureau of Labor Statistics, the average annual wage of most wildlife photographers was $50,290 per year, or $24.18 per hour, as of May 2020. So, this is a higher-paying job. Due to this reason, many new photographers have come to this field. And most wildlife photographers are freelancers. The amount of money that a freelance wildlife photographer makes is largely determined by his talent and ability to get decent-paying work. From all these things it is crystal clear that wildlife photography is one of the best careers in the world.

Wildlife photography is one of the most dangerous professions in the world. The following instances are examples of the dangers which happen for wildlife photographers. One such incident happened in May of 2000 when a female wildlife photographer was attacked and partially eaten by a 112-pound female black bear in Tennessee. Last year in Colorado a wildlife biologist and photographer, Tom Mussel, got too close to a cow elk and her calf, and he was attacked when he stumbled as he tried to escape the charging cow. Elk and deer will attack humans when they feel cornered or threatened. A southern California man killed by a grizzly bear in Alaska's backcountry was shooting photos of the animal that killed him just moments before the attack, a National Park Service official said Sunday. The bear that killed Richard White, 49, was still with his body when rangers found him in Danail National Park, the official said. Photographs found in his camera revealed that White was watching the bear for at least eight minutes near a river before the attack [02].

From our project, we mainly focused on avoiding danger for the wildlife photographer and the safety of the camera. In this period many wildlife photographers are dying while taking photos due to animal attacks. We are going to introduce a new device to avoid such a problem.
It is an Automated Camera Stand.

1 Literature Survey

In modern cameras, we have the feature to take remote photos. We call it remote photography. Therefore, we can take pictures even if we are far from the camera. But there is no way to bring the camera near to the animals rather than a person carrying the camera.

From the photographer's side:

- Danger to the life of the photographer.
- Time wastage of the photographer.
- Can't find a good angle to take a photo.
- Can't get close enough to the animal.
- Constantly changing lighting conditions.
- No safety to the camera.

From the animal's side:

- Animals get scared when we try to reach them.
- The behaviors of the animals may change.

From the environment side:

- Bad impact on biodiversity.

Therefore, when we try to find out a solution for this, we come across with some similar projects as following.

1.1 Beetle cam for wildlife photography

Figure 1.1 Beetle cam

Beetle cam has designed to take wildlife photographs. Wildlife photographer Will Burrard-Lucas had long wanted to add up-close-and-personal images of iconic African animals to his portfolio. But to get those intimate shot of lions and leopards, he would need to crawl up right next to their sharp-toothed faces. [03] This beetle cam can move forward and backward by using the remote controller. And also, beetle cam can be turned by using the wheels.

1.2 VCT-VPR1 Remote Control Tripod

This tripod has been designed to hold a camera and this is controlled by a remote controller. This tripod can check vertical and horizontal alignment using a grid line button. And also bring the subject closer with the zoom controller in the remote.

In our product we have all the functionalities same as the beetle cam and the VCT-VPR1 Remote Control Tripod. But there are some uncommon functionalities rather than these products. In our project, there is a special feature that can move the camera to the location easily by using GPS location guiding and can avoid obstacles itself. And also, can rotate the camera vertically using the remote controller. There is a siren for the safety of the camera. Both these products are foreign products. And we were unable to find out a Sri Lankan product.

2 Aim & Objectives

2.1 Aim

This project aims to the distance photography process to make sure it is safer and effective.

2.2 Objectives

The objectives of the project are as follows,

- Rotate the camera both vertically and horizontally.
- Move the stand according to the given GPS coordinates.
- Reach the target safely.
- Protect the camera from the animals by using the siren.
- Control the camera stand using a remote controller.

3 Analysis and Design

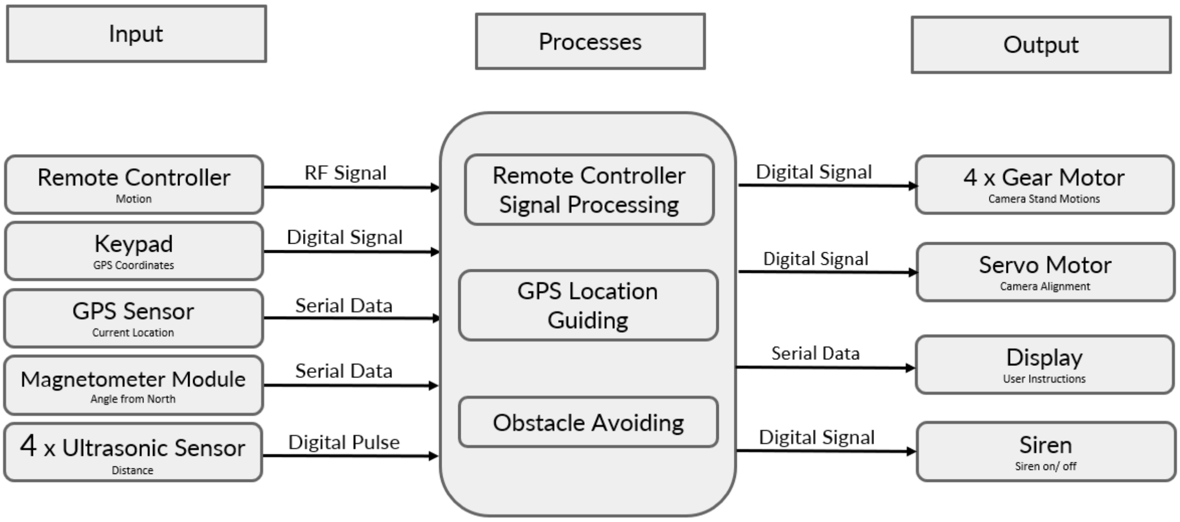

Figure 3.1 Block diagram

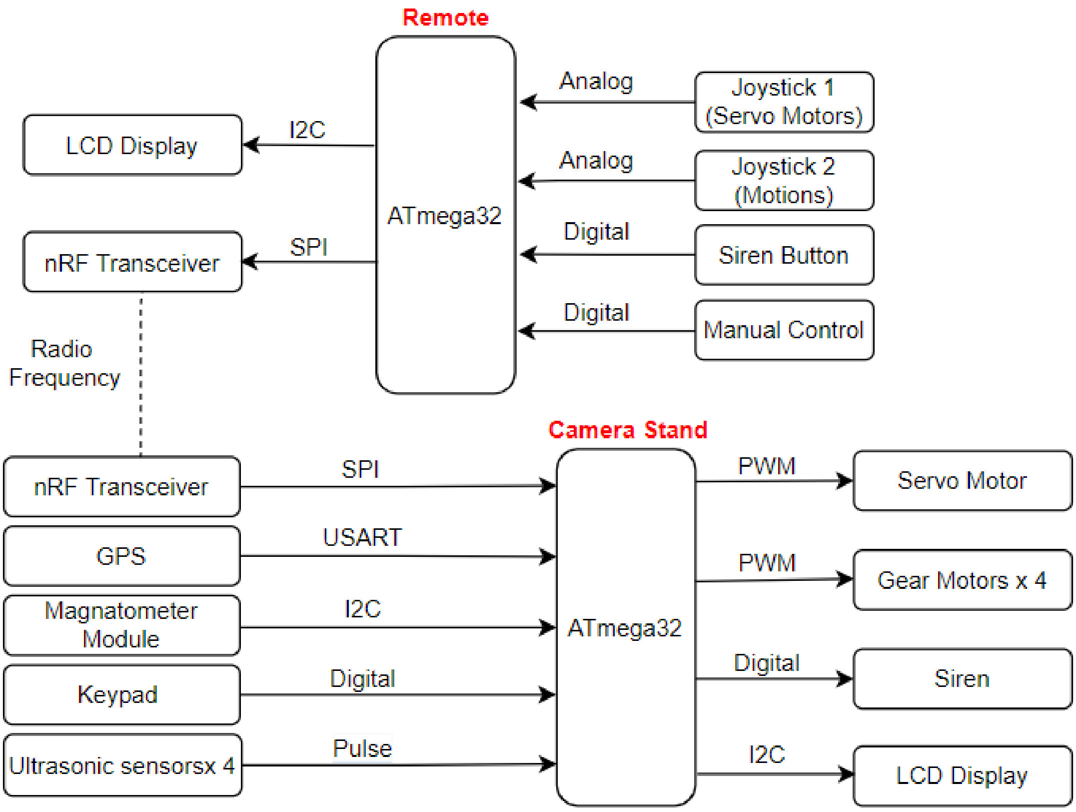

Figure 3.2 System diagram

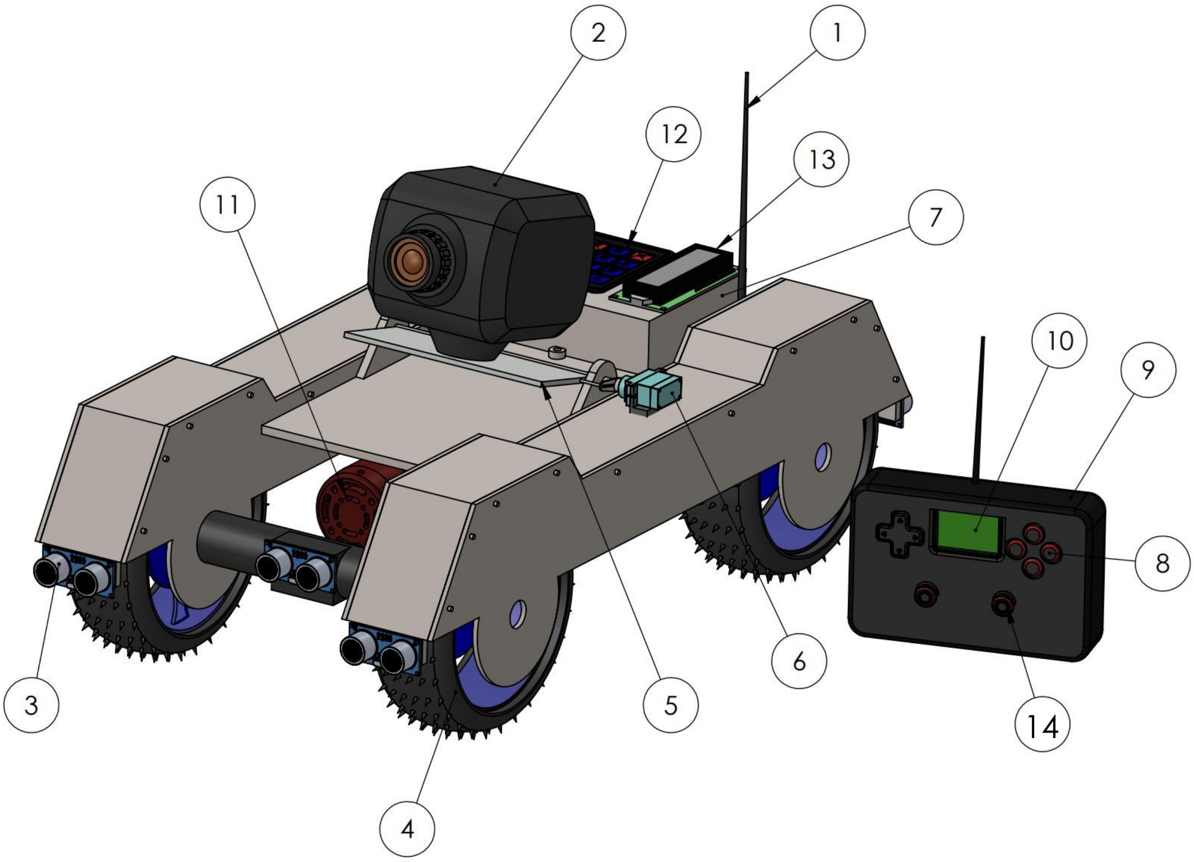

Figure 3.3 Labeled 3D diagram

1. RF Antenna
2. Camera
3. Ultrasonic sensors
4. Wheels with gear motors
5. Universal camera mount
6. Servo motor
7. Project box
    a. Atmega32 IC
    b. Compass sensor
    c. RF receiver
    d. GPS module
8. Remote controller buttons
9. Remote controller
10. LCD Display
11. Siren
12. 4x4 Numpad
13. LCD Display
14. Joystick

4 Testing and Implementation

Mainly, we have used two software for coding and simulation parts; Microchip Studio for coding the ATmega32 microcontroller and Proteus 8 Professional for simulating the circuit. We created two separate circuits using that software. One circuit for the camera stand and the other one for the remote controller.

All the members could build the code for their components and finally added all the code parts together by using git and GitHub and completed the project as a team.

In our project, there are two ATmega32 microcontrollers, one is for remote controller and the other one is for the Camera stand. The microcontroller takes inputs related to motions and angles from two joysticks. The microcontroller of the remote processes the data and transmits from remote to camera stand through nRF24L01 transceiver modules.

Then the microcontroller of the camera stand gets data from the nRF24L01 transceiver and GPS module. And also, the microcontroller of the camera stand takes inputs from ultrasonic sensors, magnetometer module and the keypad. The camera stand’s microcontroller processes that data and send them to the servo motor and gear motors. And also, send those digital signals to the display and the siren.

4.1 Circuit Diagram

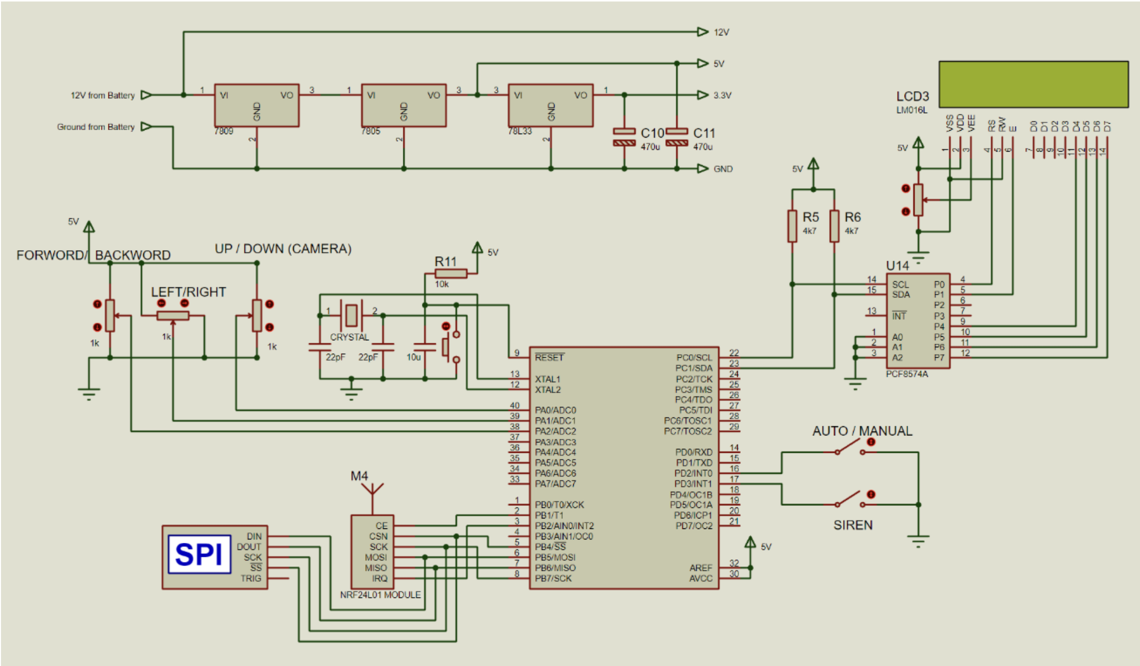

Figure 4.2 Circuit diagram - Remote

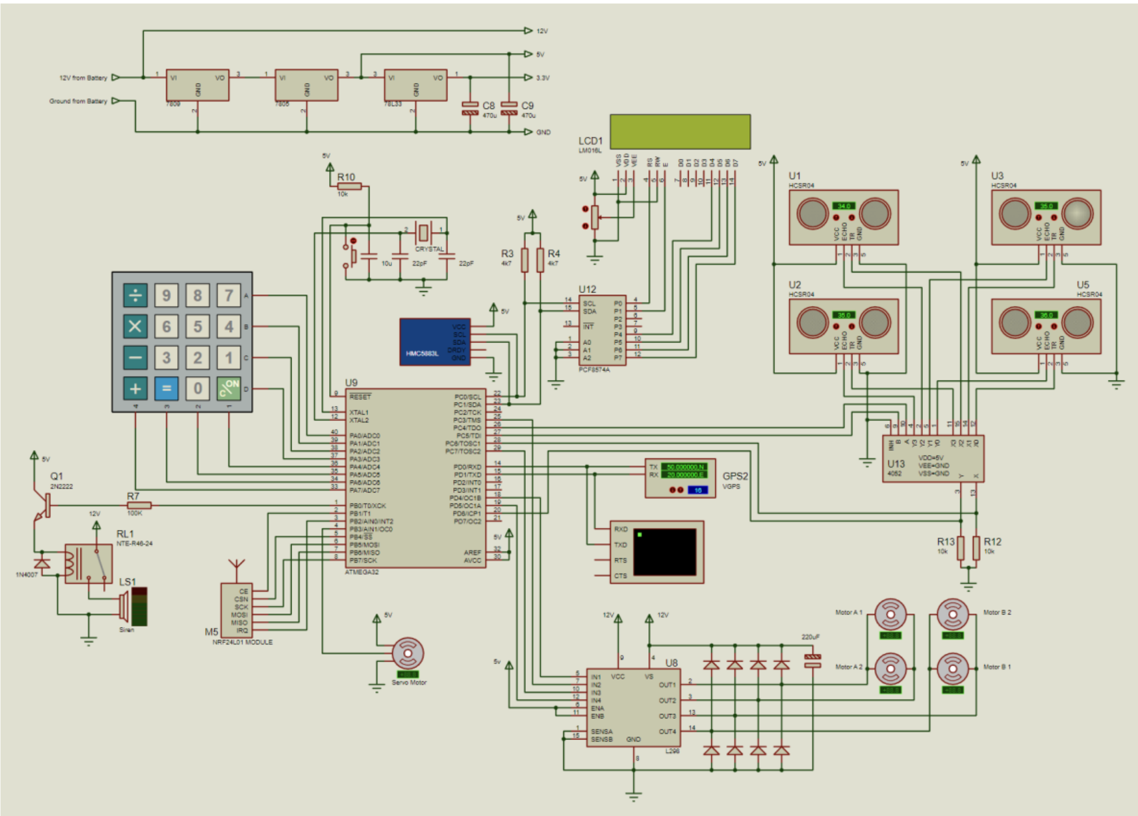

Figure 4.1 Circuit diagram - Camera stand

4.2 PCB Layout

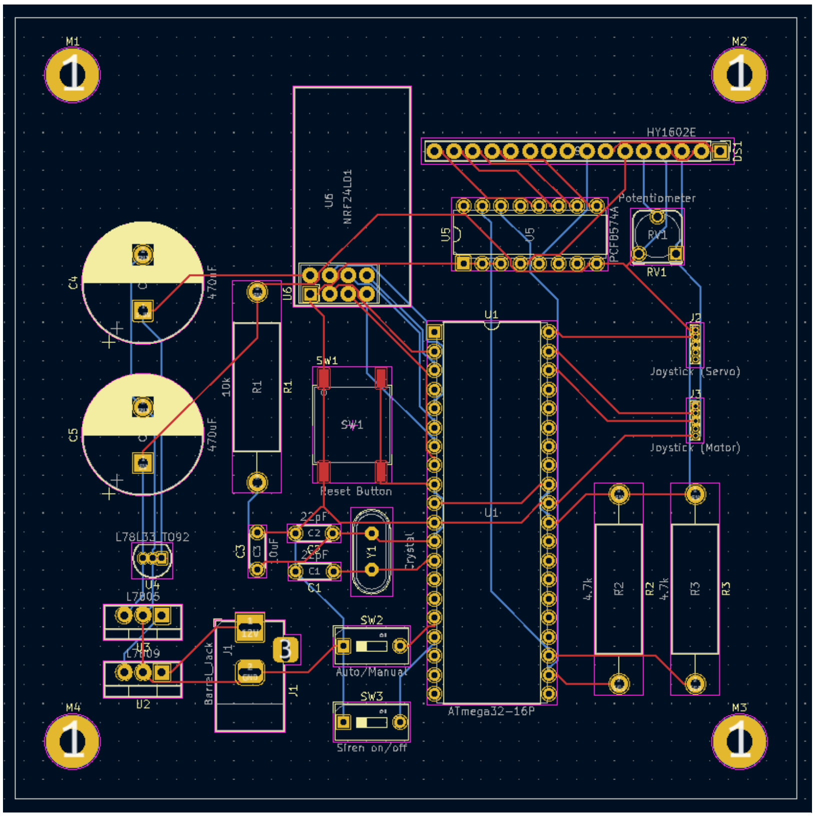

Figure 4.3 PCB - Remote

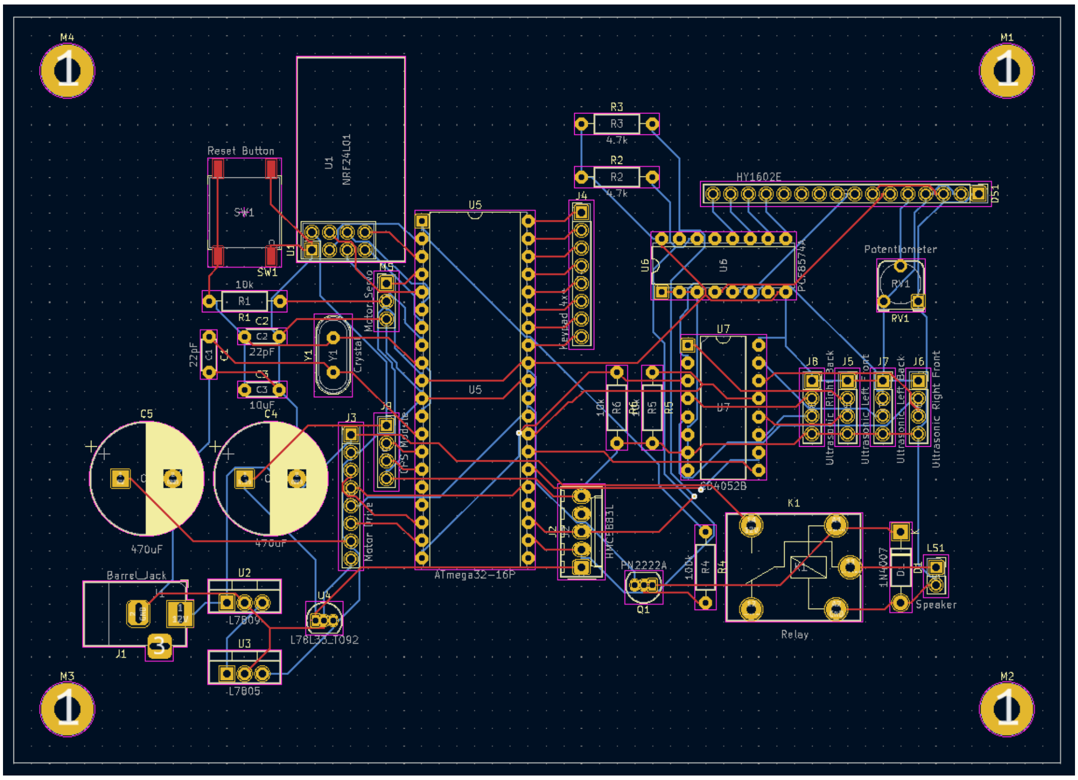

Figure 4.4 PCB - Camera stand

Appendix A

5 Cost Estimation and Expenditure so far

Component	Unit Price	Quantity	Price (LKR)
68mm RC Car Tire Wheel	Rs. 300.00	4	Rs. 1,200.00
Liquid Crystal 16x2 Display Module	Rs. 300.00	1	Rs. 300.00
2 Pin Switch	Rs. 15.00	2	Rs. 30.00
Thumb Joystick Module	Rs. 150.00	2	Rs. 300.00
nRF24L01 Transceiver Module	Rs. 1020.00	2	Rs. 2040.00
HMC5883L Magnetometer Module	Rs. 690.00	1	Rs. 690.00
Membrane Keypad - 16 Key	Rs. 180.00	1	Rs. 180.00
HC-SR04 Ultrasonic Sensor Module	Rs. 200.00	4	Rs. 800.00
NEO-6M GPS Module	Rs. 1,850.00	1	Rs. 1,850.00
L298N DC Motor Driver Module	Rs. 350.00	2	Rs. 700.00
Servo Motor	Rs. 750.00	1	Rs. 750.00
Atmega32 Microcontroller	Rs. 550.00	2	Rs. 1,100.00
11.1V 2200mAh 3S 25C Li-Po Battery	Rs. 2,800.00	1	Rs. 2,800.00
12V 2000mAh Li-Po Battery	Rs. 1,750.00	1	Rs. 1,750.00
DC Gear Motor 12v 180 RPM	Rs. 950.00	4	Rs. 3,800.00
		Total	Rs. 18,590.00

[4],[5]

6 Individual Contribution to the Project

6.1 P.A.U.D. Herath - 204074M

I am responsible for NEO -6M GPS module and HMC5883L magnetometer module in our project. I used NEO -6M GPS module to take the real time GPS coordinates which we need to calculate the angle to the user inputted GPS coordinate (user inputted GPS coordinates through the keypad) by using USART technology. I used HMC5883L magnetometer module to take the current facing direction of the camera stand according to the True North by using I2C technology.

6.1.1 NEO -6M GPS module

The GPS module uses the USART technology to communicate with the microcontroller. And when taking the specifications of the GPS module, the operating voltage lies between 2.7V to 3.6V. I give 3.3 V to the GPS module. In the GPS module, there is a GPS antenna to take GPS signals through Radio Frequency which are sent from the GPS satellites. Its serial baud rate lies between 4800 bits per second to 230,400 bits per second. But the default serial baud rate is 9600 bits per second. The max supply current for this module is 67 mA. The operating current is 45mA.

When taking the pin configuration of the GPS module, there are 4 pins. Vcc pin is for power supply and GND pin is used to ground the GPS module. TXD pin is for the transmission of data and the RXD pin is for the receiving of data. The GPS module has a GPS antenna, battery, an EEPROM and a position fix LED indicator. In this project, the only target is to transfer data from the GPS module to the Atmega32 chip, and therefore it is only needed to connect the TXD pin of the GPS module with the atmega32 RXD pin. RXD pin is the 14th pin. Understood that the D0 and D1 pins must be used to take the serial data using the GPS module. This is all about the pin configuration of the GPS module.

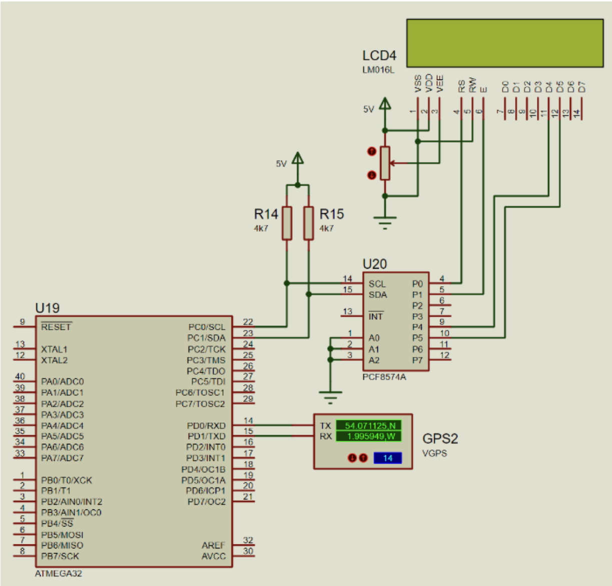

Figure 6.1 Circuit diagram - GPS module

6.1.2 Magnetometer Module (HMC5883L)

For the GPS location guiding algorithm, identifying the current facing direction of the camera stand is a must. The HMC5883L magnetometer module is used for that. This uses the I2C protocol for communication with the Atmega32 microcontroller. According to the documentation, the supply voltage for the magnetometer module lies between 2.7 V to 6.5 V. The operating voltage is 3.3V. The frequency to pass serial data is up to 400kHz and the operating temperature is between -22 to 185 Fahrenheit. The pin configuration is that there are 5 pins in the magnetometer module. The Vcc pin takes power to the module, and the GND pin is to ground. SCL is the serial clock pin, and the SDA is the serial data pin. DRDY is the data-ready interrupt pin. I2C is a serial communication protocol. For I2C the SCL and the SDA pins must be used. SCL pin is the 22nd pin in the Atmega32 microcontroller and SDA pin is the 23rd pin in the Atmega32 chip. I will be no need to connect the DRDY pin of the magnetometer module to the Atmega32 microcontroller. We can connect to 255 components to this I2C bus in this Atmega32 microcontroller. And therefore, not only the magnetometer module but also, we had to connect the LCD display also to this I2C bus.

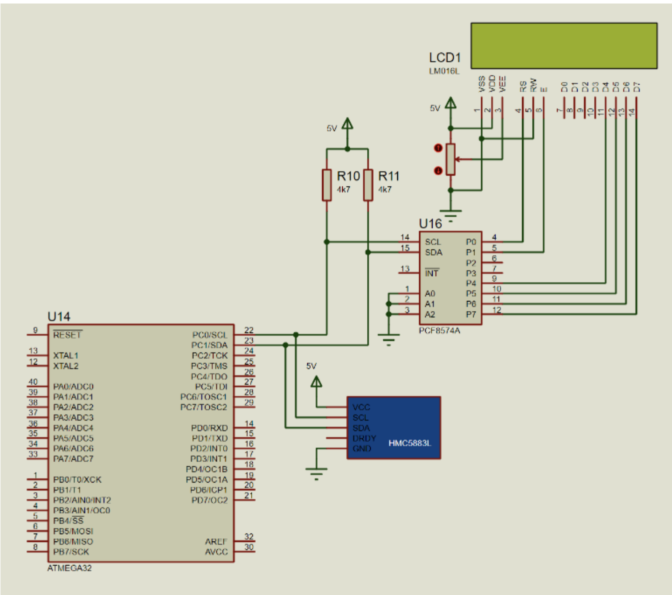

Figure 6.3 Circuit diagram - Magnetometer

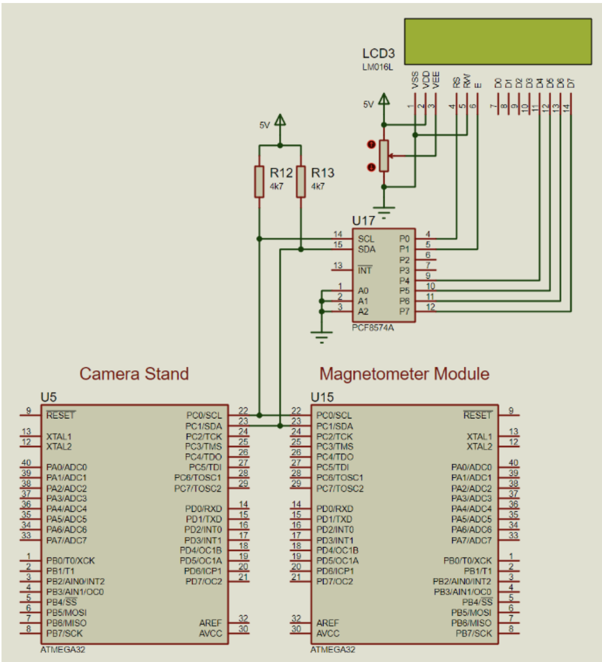

Figure 6.2 Circuit diagram - Magnetometer (Simulation)

PCB for GPS module and Magnetometer Module

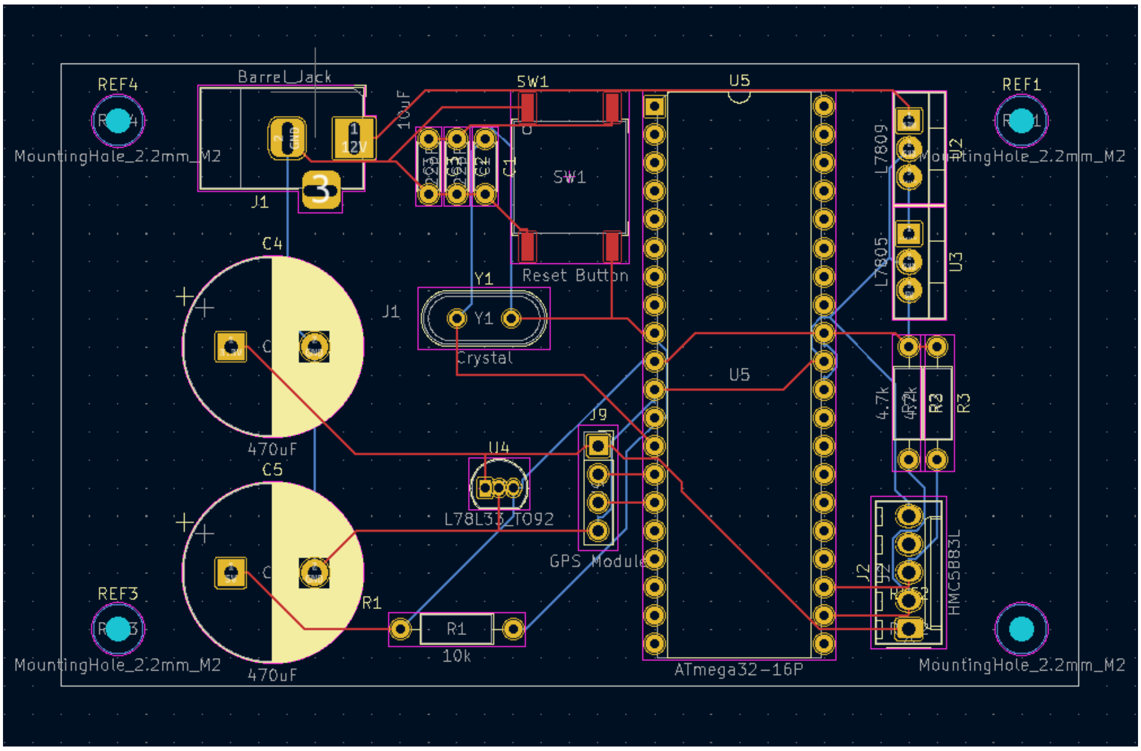

Figure 6.5 PCB - GPS and Magnetometer module

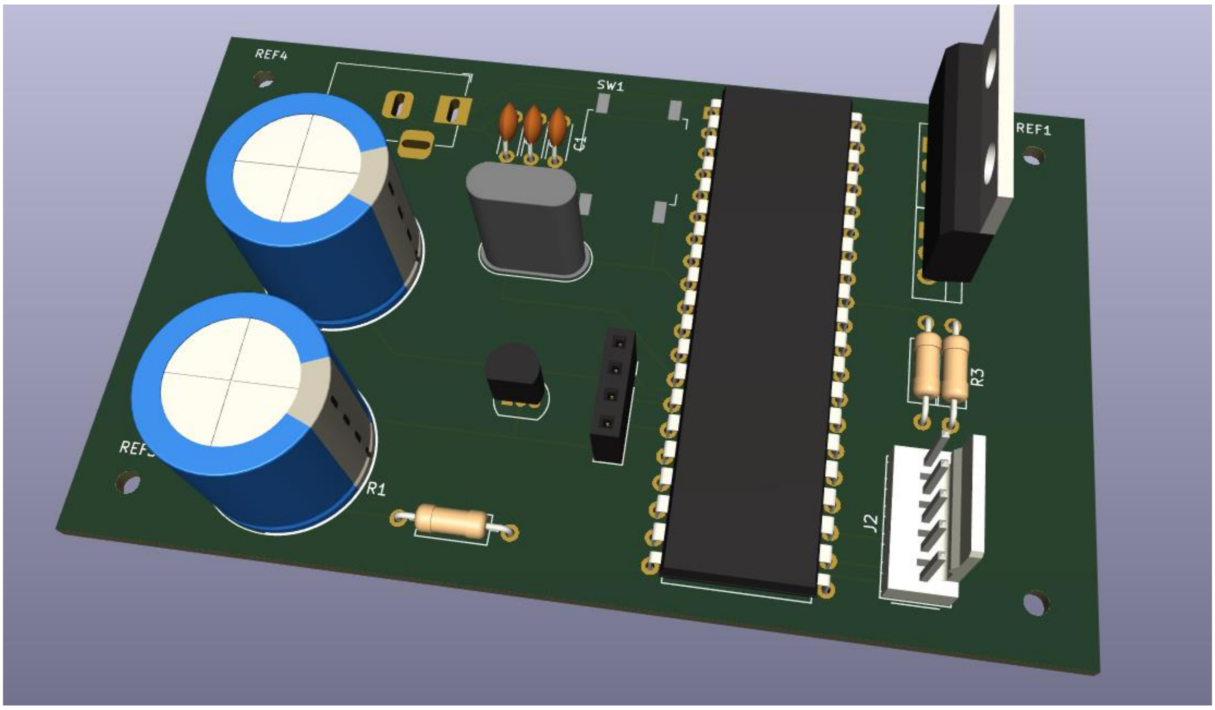

Figure 6.4 GPS and Magnetometer module 3D

6.2 P.H.P. Jayathilaka - 204087F

I am responsible for LCD 16×2 display, L298N motor drive module, Gear motors and switches. I have used LCD 16×2 display to display GPS coordinates, to display the status (auto or manual) and to display user messages. I used I2C protocol to maintain the connection between Atmega32 microcontroller of the camera stand and the LCD display due to lack of pins of the microcontroller to connect directly. I used gear motors to move the camera stand by rotating the wheels finding the correct path. And I used PWM for that. And also, I had used two switches to change the current state of the camera stand as auto and manual and on and off the siren in the camera stand.

6.2.1 Liquid Crystal 16 × 2 Display

LCD displays are used to show GPS coordinates and the current remote's configurations. Because of this LCD display, the camera stand becomes more user friendly. The LCDs have a parallel interface that the microcontroller has to manipulate several interface pins at once to control the display.

The interface consists of many numbers of pins. A register selection (RS) pin that controls writing data in the LCD's memory. There is a capability of selecting either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next. There is a pin named Read/Write (R/W) to select the reading mode or writing mode and has an enable pin that enables writing to the registers. There are 8 data pins (D0 -D7). The states of these pins (high or low) are the bits that user is writing to a register when write, or the values user is reading when read. There is a display contrast pin (Vo), power supply pins (+5V and GND) and LED Backlight pins that can use to power the LCD, control the display contrast, and turn on and off the LED backlight, respectively. The process of controlling the display involves putting the data that forms the image of what user wants to display into the data registers, then putting instructions in the instruction register.

We use 2 "16 by 2" LCD displays for the remote controller and the camera holder. It is working between 3.3V to 5V and 1.5mA to 2.5mA. We use this display to give user instructions and current status of the system. PCF8574A Remote 8-Bit I/O Expander to I2C. The display uses the 4-bit configuration to communicate with the microcontroller. We had to use SPI pins for the nRF module. So I can’t connect the LCD display and nRF module together. Due to that reason, I connect the LCD display via the I2C protocol. I use have to use 8-Bit I/O Expander to I2C IC module to interface with LCD display and microcontroller via I2C protocol. We selected address through A0, A1 and A2 pins.

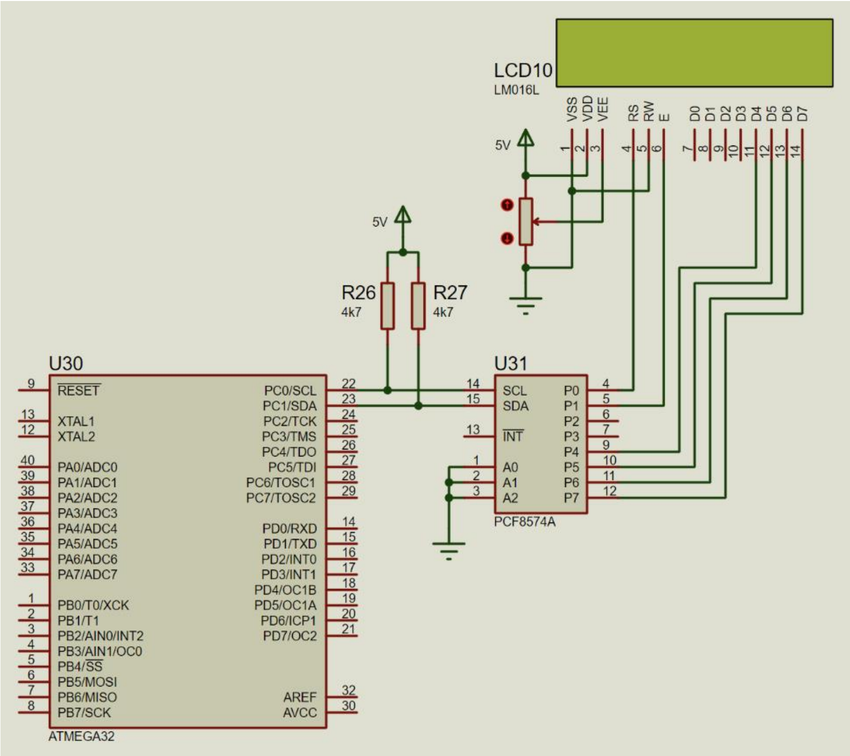

Figure 6.6 Circuit diagram - 16x4 LCD

6.2.2 Motor drive L298N

Motor drive is used to amplify the PWM signal from the Atmega32 and supply it to the gear motors. This drive can handle up to 50V and a maximum of 2.5A. Maximum logical supply and enable voltages are 7V. This is a dual full-bridge driver. So, both sides can be handled by a single drive. Pin configuration is quite simple. There are two input pins, two output pins and a single enable pin for each side.

I used a L298N motor drive for our project. This drive can handle up to 50V and a maximum of 2.5A. Maximum logical supply and enable voltages are 7V. This is a dual full-bridge driver. So both sides can be handled by a single drive. Pin configuration is very simple. There are 2 input pins, 2 output pins and a single enable pin for each side. If so we have to use a couple of these drivers for the project. The PWM pins are not enough for all 4 motors. Therefore, we have connected the two left-side motors and two right-side motors separately as duals. Then we are doing the work which is done by using 8 pins; by using just 4 pins. But we cannot use all 4 PWM pins in the Atmega32 microcontroller. So we use one PWM pin and 1 digital pin for each side. From that, we can save 2 PWM pins for the rest of the tasks.

6.2.3 Gear motor

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters regarding gear motors are speed (rpm), torque and efficiency. To select the most suitable gear motor load, speed and torque required for the application have to be measured correctly. Most DC motors can be complemented with unique gearheads. The working voltage is 12V DC. Speed is 180 RPM. It is a high torque motor and using L298NH – bridge motor drive.

By considering all these features in the gear motor, it's better to use that type of motor for the wheels of the camera holder. [2] Due to lack of eight PWM pins for four motors, I had to couple motors as left and right. Then needed PWM pins reduced to four. Furthermore, I used only one PWM pin and a digital pin per side. It is configured by code.

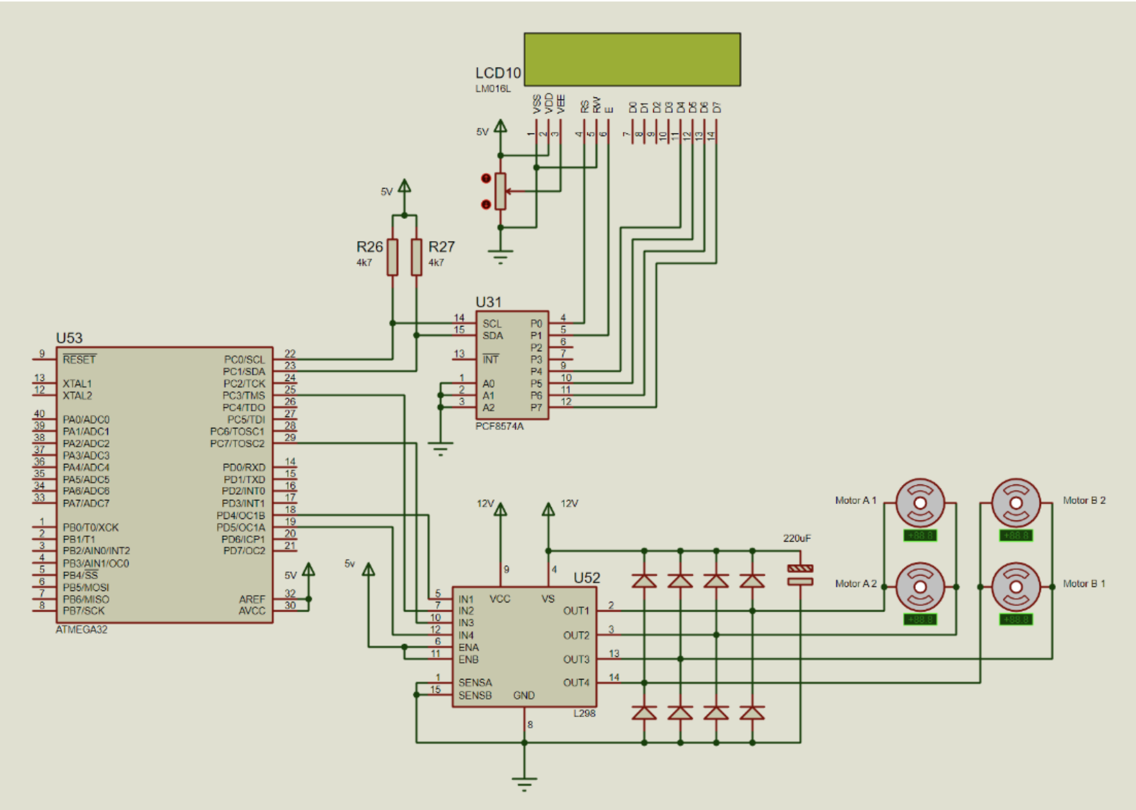

Figure 6.7 Circuit diagram - Gear motors

PCB for Motor drive and 16x2 LCD

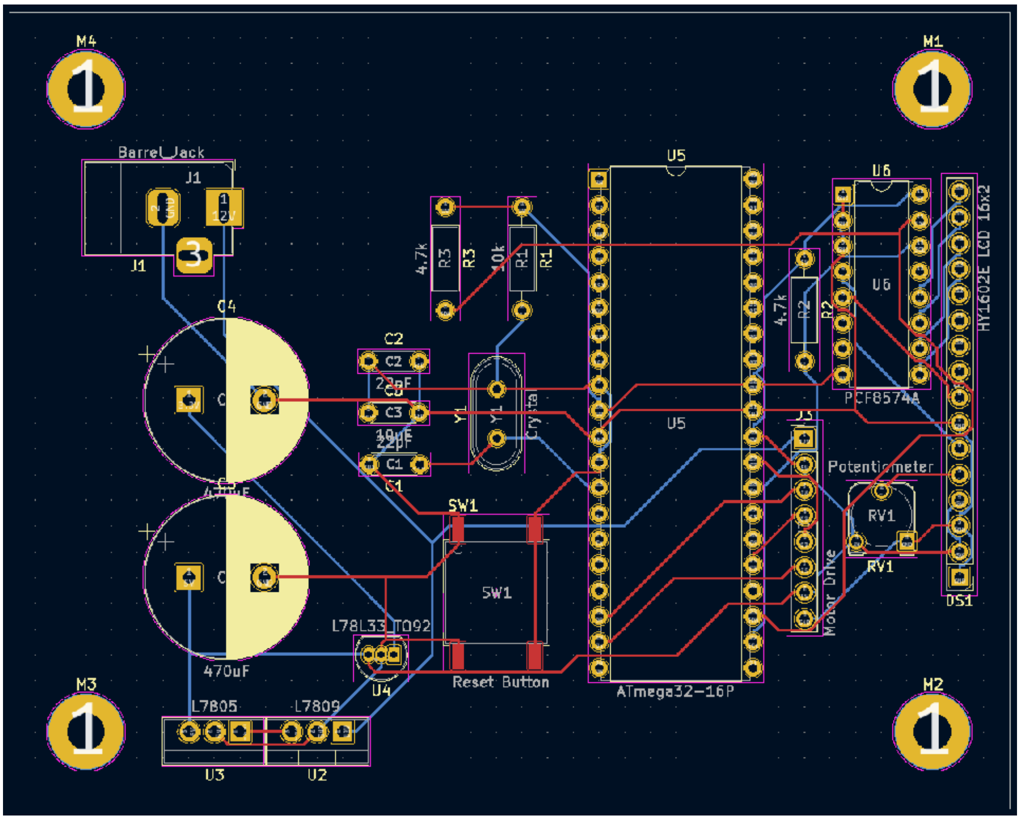

Figure 6.9 PCB – Motor drive

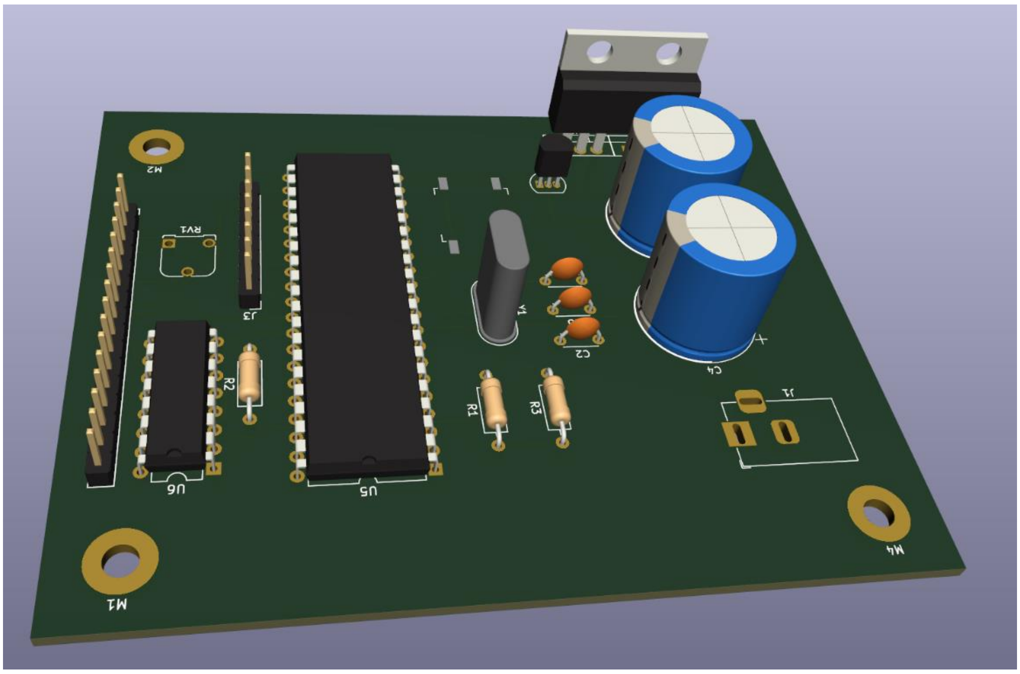

Figure 6.8 PCB - Motor drive 3D

7.2.3 Toggle switch

There are 2 switches in the remote control. One for the siren and one to shift between auto mode and manual mode. We do not use pull-up resistors. But we manage to prevent debouncing by make the pin as pullup from the microcontroller.

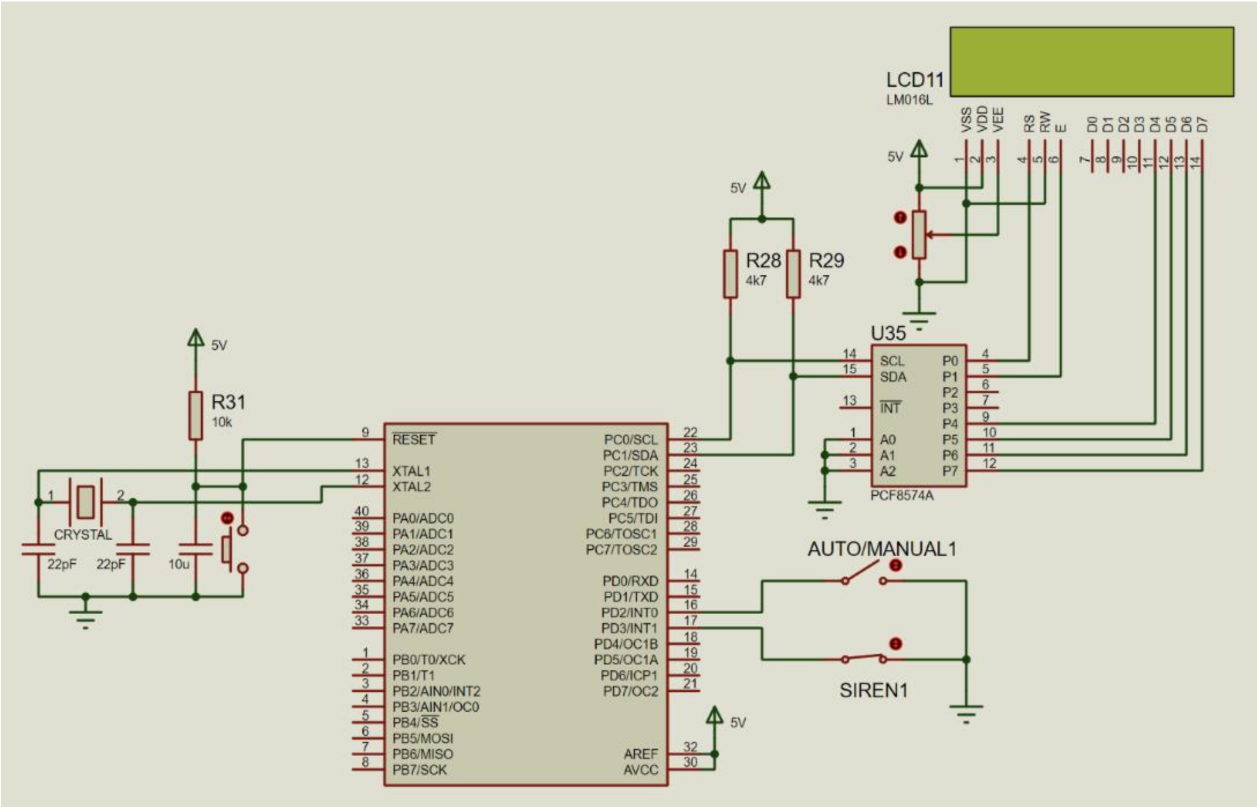

Figure 6.10 Circuit diagram - Toggle switches

PCB for Toggle switch and 16x2 LCD

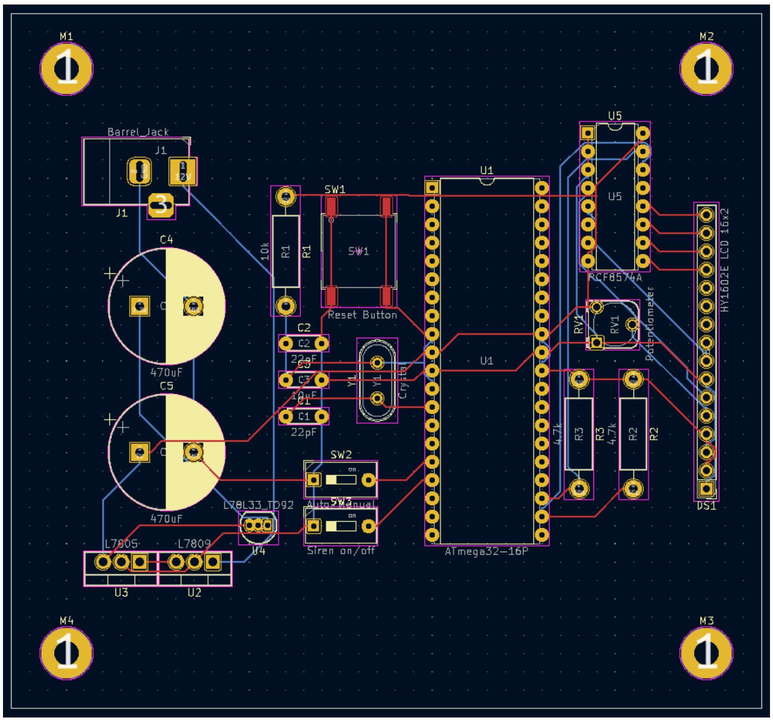

Figure 6.12 PCB - Toggle switch and Display

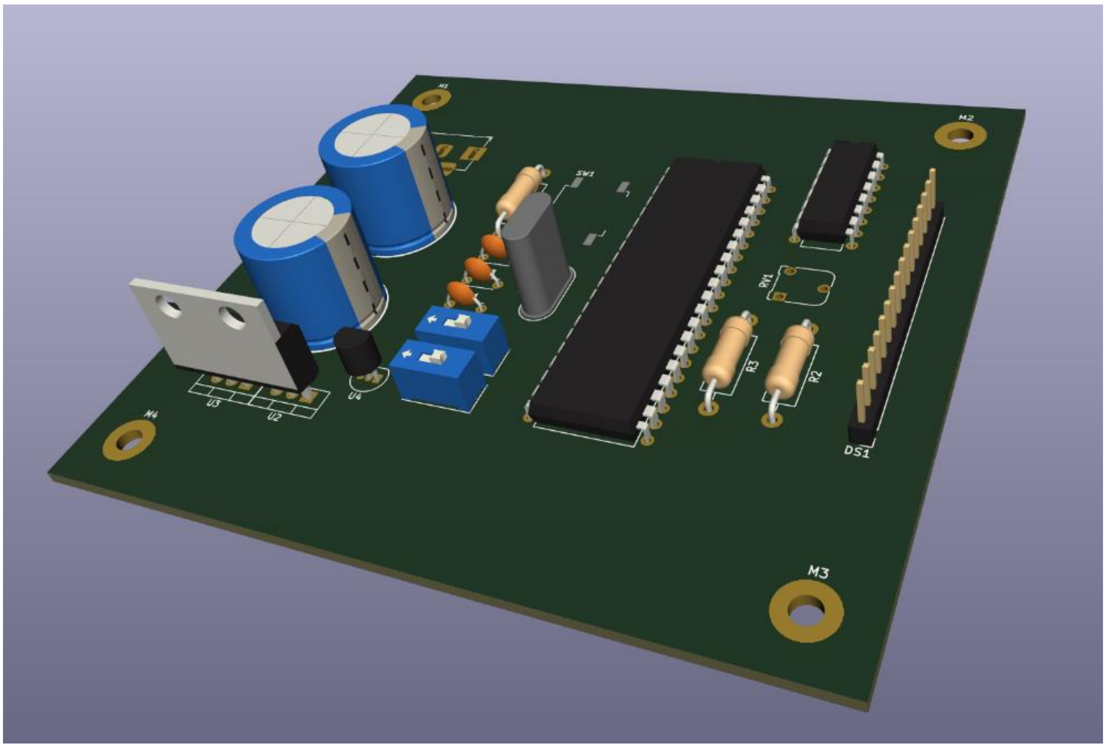

Figure 6.11 PCB - Toggle switches and Display 3D

6.3 D.M.B.M. Dissanayake - 204047J

In our project I am responsible for the Thumb Joystick Module, nRF24L01 Transceiver module as transmitter and Ultrasonic sensors. I have to use SPI (Serial Peripheral Interface) and ADC technology. I have used a joystick to get inputs related to the angle of servo motors. The microcontroller of the remote gets analog inputs from this joystick. We need knowledge about ADC on AVR ATmega32 to process that analog signal. To get this analog input, I had to use A0 pin in the ATmega32 microcontroller. Furthermore, I have used a nRF24L01 transceiver module to transmit the above-processed data from the microcontroller. I am using four ultrasonic sensors to avoid obstacles.

6.3.1 Thumb Joystick

I used a thumb joystick module to get input to set the vertical angle of the camera. We can move the camera up and down using this joystick. The joystick uses ADC to communicate with the microcontroller. The joystick is a device that translates our hand movement into an electronic signal, and the movements are converted by the computational unit into entire mathematics, in other words, the joystick translates entirely physical movements. The operating voltage of the joystick is 5V. The operating current is 3.5 mA. In the joystick module, internal potentiometer values are 10kΩ. The operating temperature of this joystick module is 0 to 70 C. There are 5 pins in the joystick module. The first one is the GND pin. I connect this pin to the ground. I am using VCC pin to supply power to the module. The third pin is the VRX pin. Using this pin, I can get a readout of the joystick in the horizontal direction, that means the input related to the X-axis. The fourth pin is the VRY pin, using this pin, I can take a readout of the joystick in the vertical direction, that means the input related to the Y-axis. The last pin is the SW pin. This is the output of the internally connected push button. It is normally open; it means that the digital readout from the SW pin will be high. When the button is pushed, it will connect to the ground by giving output as low.

There is no joystick module in proteus. Therefore, I used a variable resistor to connect with the microcontroller.

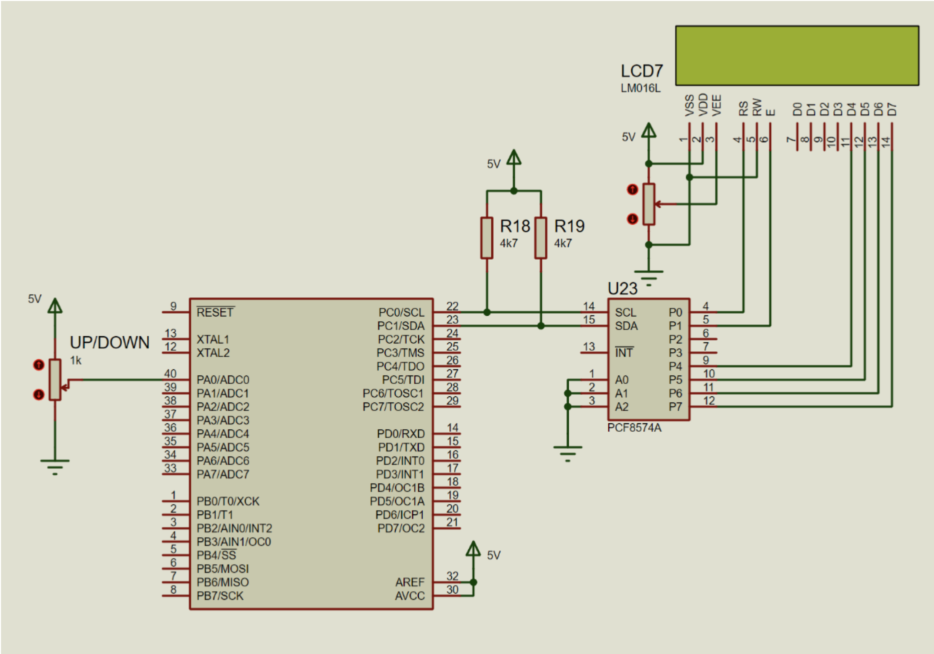

Figure 6.13 Circuit diagram - Joystick for servo

6.3.2 nRF24L01 Transceiver Module

nRF24L01 transceiver module to communicate with remote controller and the camera stand. Using nRF24L01 module I transmit all controlling instructions to the camera stand. This module uses radio frequencies for that. The nRF24L01 transceiver module is designed to operate in 2.4 GHz worldwide ISM frequency band and uses GFSK modulation that means gaussian frequency shift keying modulation for data transmission. The data transfer rate can be one of 1Mbps and 2Mbps. And also, this module has both transmitter and receiver components. The operating voltage of the module is from 1.9 to 3.6V, and we supply 3.3 V to the module. Due to logic pins are 5-volt tolerant, so we can easily connect it to any 5V logic microcontroller without using any logic level converter.

The module supports programmable output power viz. 0 dBm, -6 dBm, -12 dBm or -18 dBm and consumes unbelievably around 12 mA during transmission at 0 dBm, which is even lower than a single LED. And best of all, it consumes 26 µA in standby mode and 900 nA at power down mode. Operating temperature is -40 to 85 Celsius. In transmitter mode I supply 11.3 mA current to the module. It is important to never to keep the nRF24L01 transceiver module is never in TX mode longer than 4ms. We can communicate over a distance of 2 km using this nRF24L01 module.

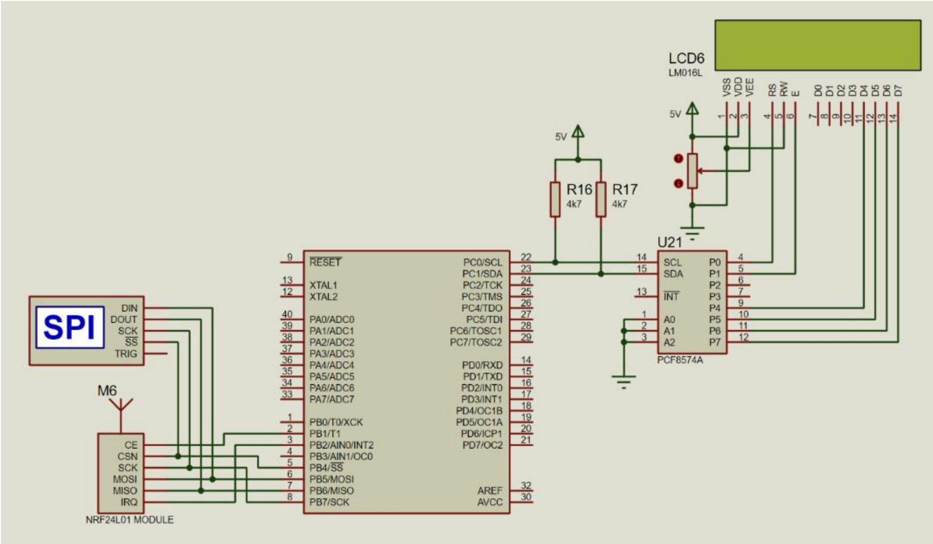

Figure 6.14 Circuit diagram - nRF transceiver module

PCB for nRF Transceiver Module

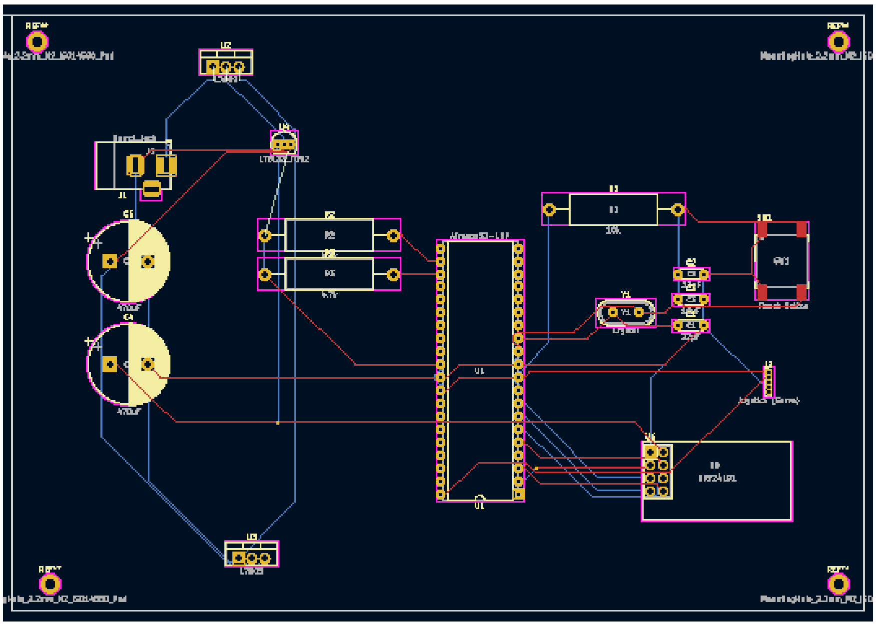

Figure 6.15 PCB - nRF transceiver module

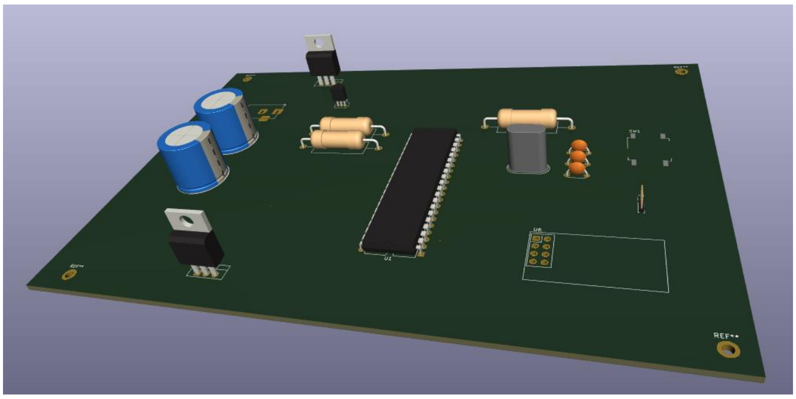

Figure 6.16 PCB - nRF transceiver module

6.3.3 Ultrasonic sensor

. There are 4 pins in the ultrasonic sensor. (VCC, Trig Pin, Echo Pin, GND)

The working power of the ultrasonic sensor is DC 5V and operating current 15mA. The working frequency is 40Hz, accurate range is 2cm – 40cm, the measuring angle is 15 degrees, trigger input signal is 10µS TTL pulse echo output signal input TTL lever signal and the range in proportion.

An ultrasonic sensor is an electronic device which measures the distance to an object by emitting an ultrasonic sound wave and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound. Ultrasonic sensors have two parts as the transmitter and receiver. Transmitter sends an ultrasonic sound wave and then the receiver receives that wave and calculate the time took to come back to the receiver. And using these data, ultrasonic sensor calculates the distance which has to that particular object. This is the way how the ultrasonic sensor works. By considering all these features of the ultrasonic sensor it can be used to detect obstacles.[7]

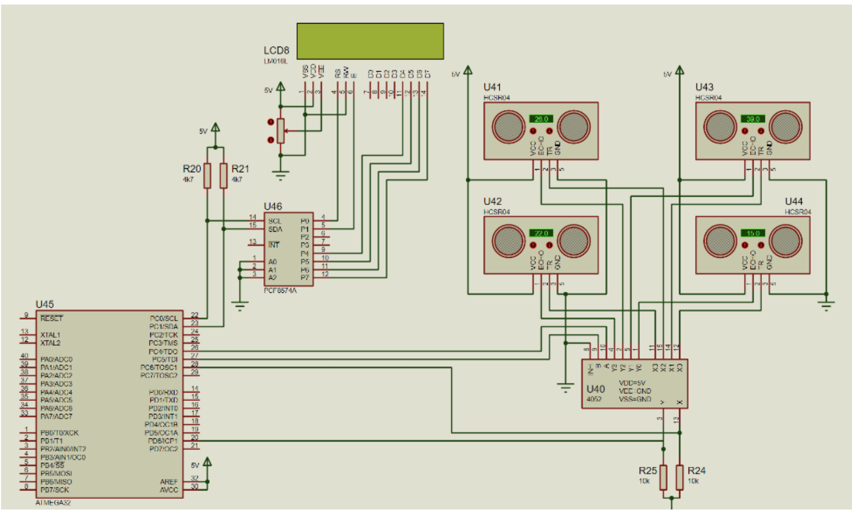

Figure 6.17 Circuit diagram - Ultrasonic sensors

PCB for Ultrasonic sensors

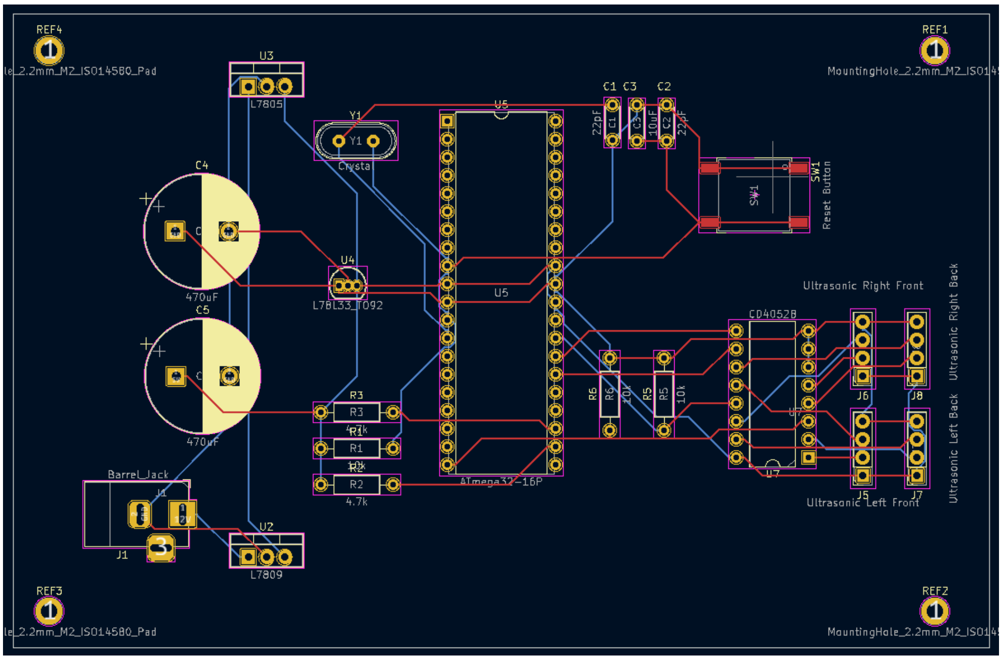

Figure 6.18 PCB - Ultrasonic sensors

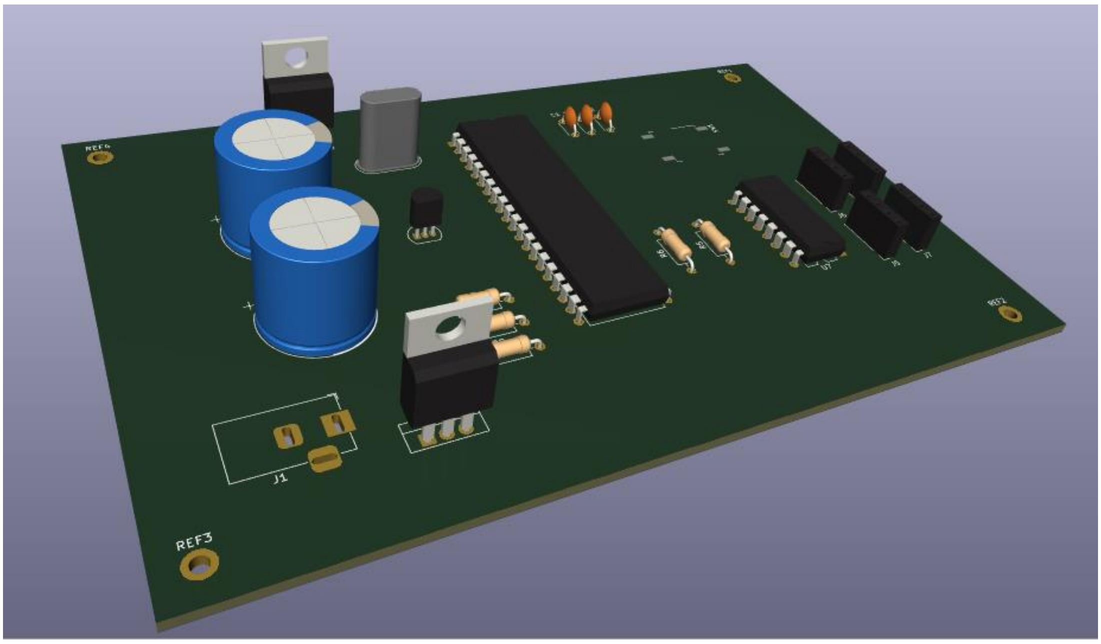

Figure 6.19 PCB - Ultrasonic sensors 3D

6.4 S.P.S.N. Pathirana - 204150T

In this project, I am responsible for the servo motor and the siren. I have to change the vertical angle of the camera when taking a photo of a wild animal, by using a servo motor. And also, have to sound a siren according to the user inputs.

6.4.1 Servo Motor

Servo motor is used for changing the vertical angle of the camera within 90 degrees. When we take a photo of a wild animal, we have to change the direction of the camera according to the direction of the animal.

When the signal is received to the Atmega32 microcontroller in the host, it provides a signal to make the correct angle of the servo motor. For that I used the PWM method to process that.

It has three colour wires. The red colour wire should be connected to the power supply. Brown colour wire connects to the Ground and the Orange colour wire connects to the PWM signal given by the Atmega32 in the host.

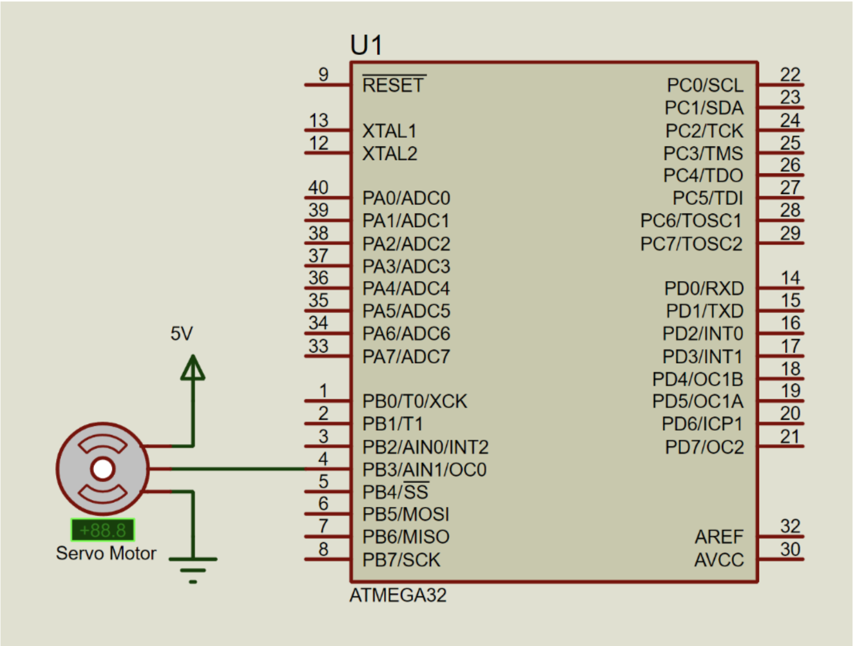

Figure 6.20 Circuit diagram - Servo motor

These are the specifications of servo motor: weight is 55 g, operating voltage is 5V, operating maximum current is 900mA and the power is 4.5W.

6.4.2 Siren

The siren is used to protect the camera stand. When the wild animals come to attack the camera stand, we just sound the siren to chase away the animals. When the user switches on the siren button to sound the siren, a digital signal is passed from the remote controller the siren.

When considering the specifications, the operating maximum voltage is 12V, the operating maximum current is 1.5A, Sound intensity is 112 -116 decibels and speed is 1000 rpm and power is 18W.

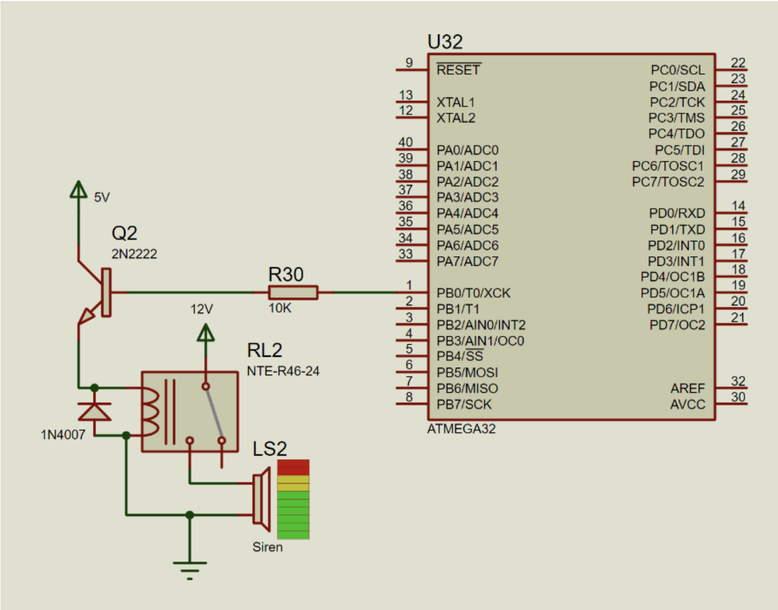

Figure 6.21 Circuit diagram - Siren

PCB for Siren and Servo motor

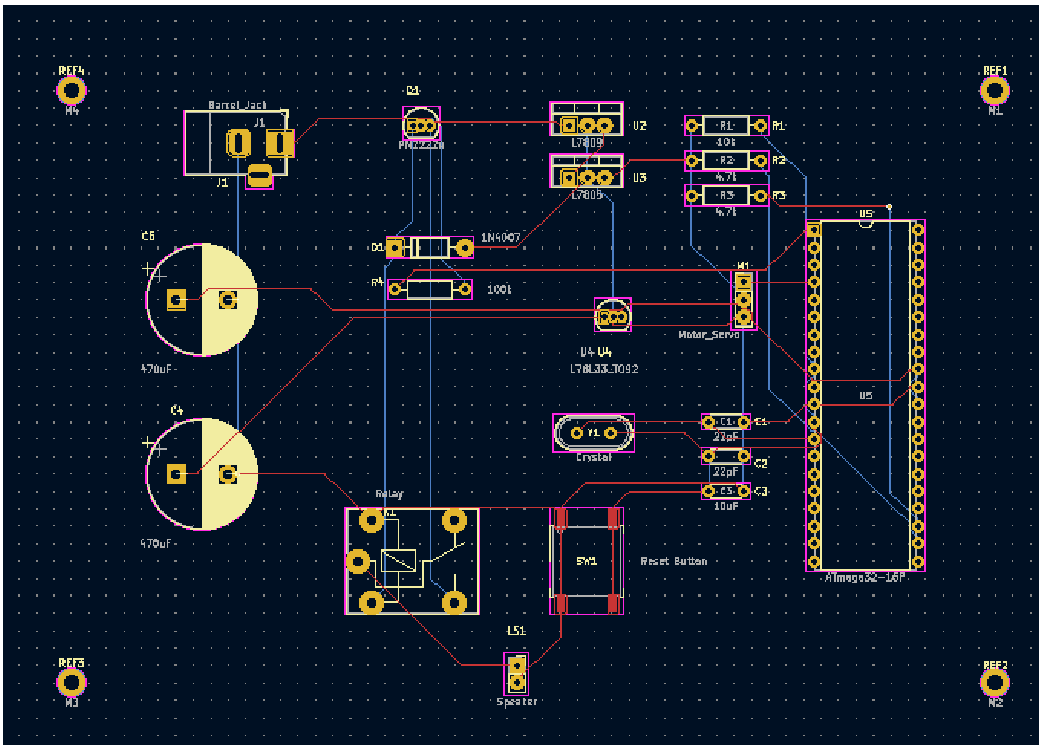

Figure 6.22 PCB - Siren and Servo motor

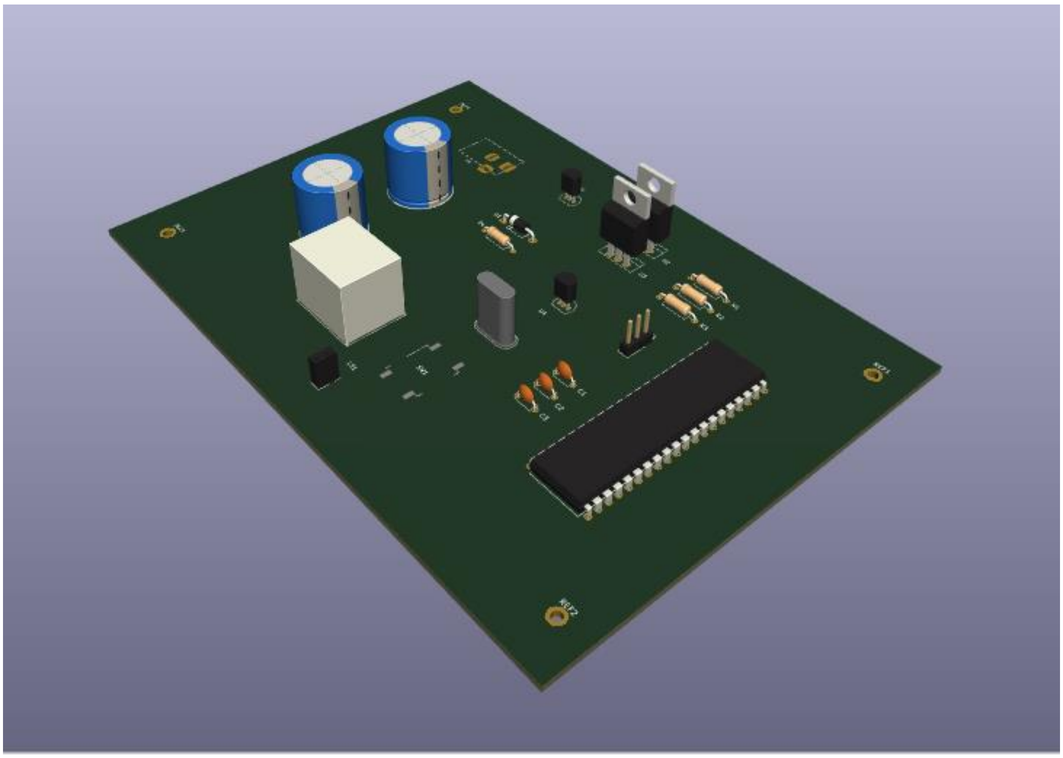

Figure 6.23 PCB - Siren and Servo motor 3D

6.5 A.M.D.B. Rathnayaka - 204179N

I am responsible for the Thumb Joystick module, nRF24L01 Transceiver module as receiver and 4x4 keypad. I use ADC Technology and SPI concepts. I have to give inputs to the ATmega32 microcontroller of the remote through the joystick and it uses the ADC Technology for that. Moreover, it gives inputs to the microcontroller of the camera stand from the nRF24L01 Transceiver of the remote controller. nRF24L01 Transceiver uses the SPI to communicate with the Atmega32 microcontroller of the host.4x4 keypad is mainly used to get the GPS coordinates from the user. If necessary, it is used to get some configuration from the user.

6.5.1 Thumb Joystick

In our project I use this joystick to give analog inputs to the ATmega32 microcontroller related to

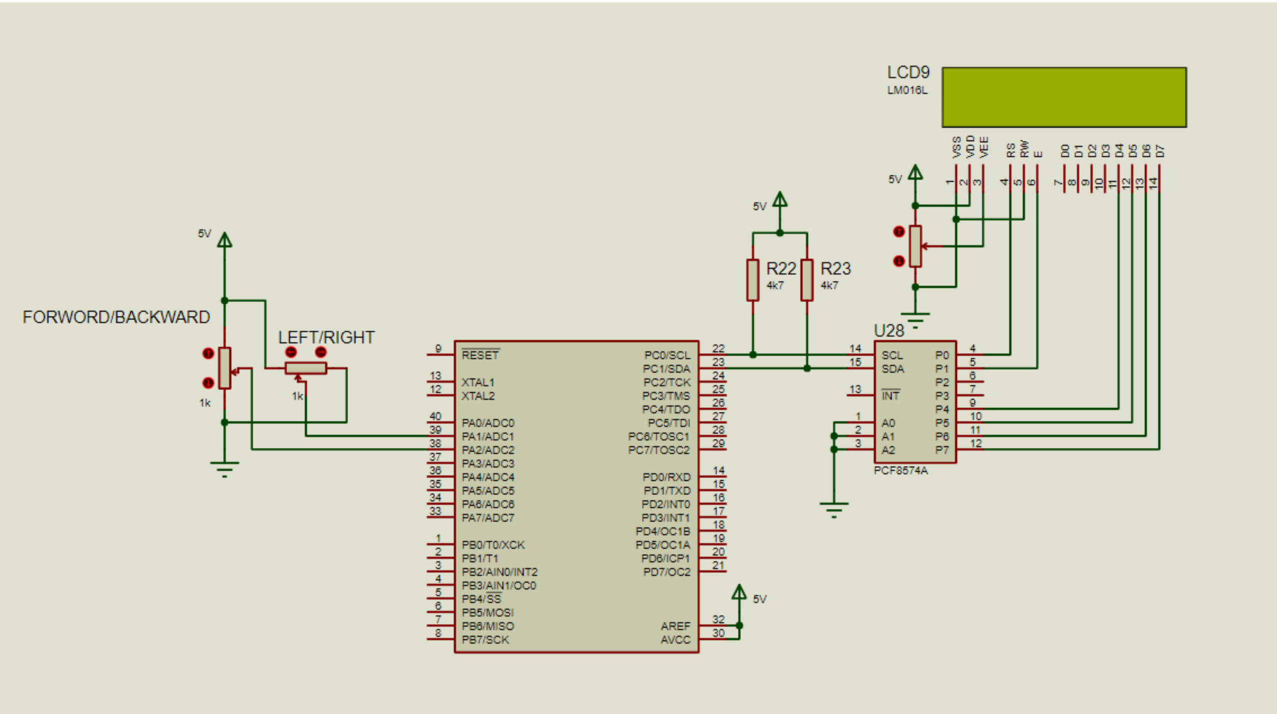

Figure 6.24 Circuit diagram - Joystick for motors

the motions such as moving forward backward and moving left right by using ADC technology.

The joystick is a device that translates our hand movement into an electronic signal, and the movements are converted by the computational unit into entire mathematics, in other words, the joystick translates entirely physical movements.

The operating voltage of joystick module is 5V. The operating current is 3.5 mA. In the joystick module, internal potentiometer values are 10kΩ. The operating temperature of this joystick module is 0 to 70 C. There are 5 pins in the joystick module. The pins in this module are VCC, GND, VRx, VRy, SW. It is used to control the pointer movement in 2-dimension axis. It is made by mounting two potentiometers at a 90 degrees angle to read user's input. The potentiometers are connected to a short stick centered by springs. One potentiometer is used to get the analog output voltage for X-Direction movement related to move the camera stand forward backward and the other potentiometer is used to get the analog output voltage for Y-Direction movement related to move the camera stand left right. The potentiometers are connected between +VCC and Ground. They simply behave as voltage divider network

The joystick has one freewheeling Holder. According to the holder movement, the potentiometer knob changes its position and resistance of the potentiometer. This module produces an output of around 2.5V from X and Y when it is in resting position. Moving the joystick will cause the output to vary from 0v to 5V depending on its direction. If we connect this module to a microcontroller, we can expect to read a value of around 512 in its resting position. When we move the joystick, we should see the values change from 0 to 1023 depending on its position. There is no joystick module in proteus. Therefore, I used two variable resistors to connect with the microcontroller.

PCB for Joystick

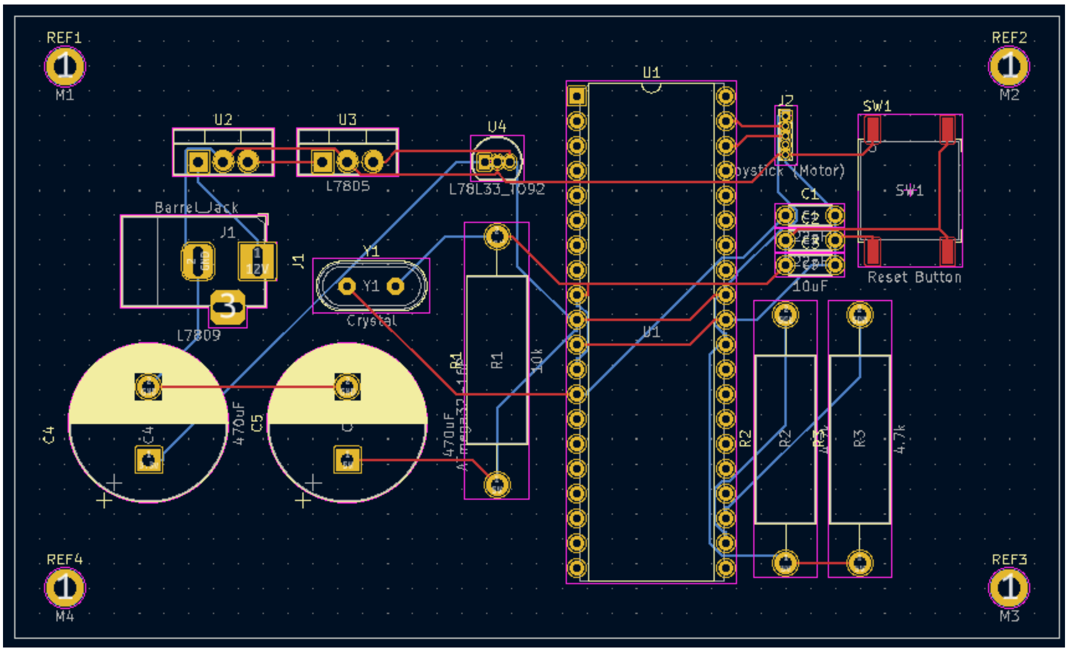

Figure 6.25 PCB - Joystick for motors

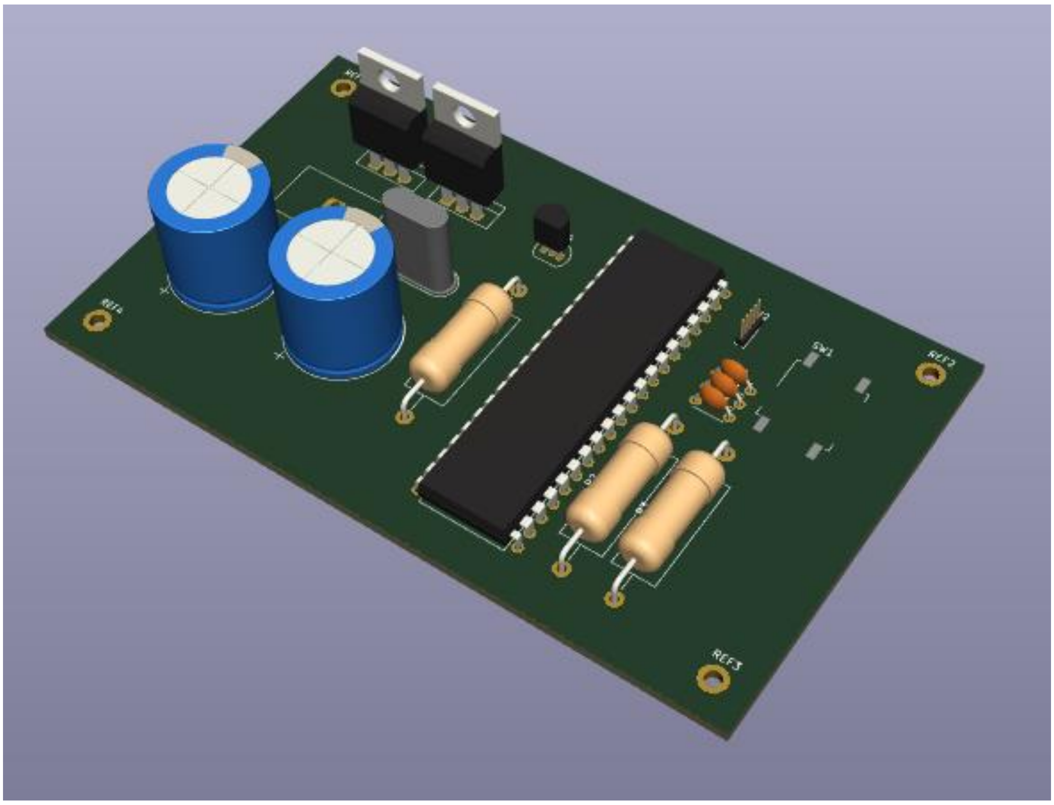

Figure 6.26 Joystick for motors 3D

6.5.2 nRF Transceiver module

I use nRF24L01 transceiver module to communicate with remote controller and the camera stand. Using nRF24L01 module I receive all controlling instructions from the remote controller. This module uses radio frequencies for that.

The nRF24L01 transceiver module is designed to operate in 2.4 GHz worldwide ISM frequency band and uses GFSK modulation that means gaussian frequency shift keying modulation for data transmission. The data transfer rate can be one of 1Mbps and 2Mbps. The operating voltage of the module is from 1.9 to 3.6V, and we supply 3.3 V to the module. Due to logic pins are 5-volt tolerant, so we can easily connect it to any 5V logic microcontroller without using any logic level converter. The module supports programmable output power viz. 0 dBm, -6 dBm, -12 dBm or -18 dBm and consumes unbelievably around 12 mA during transmission at 0 dBm, which is even lower than a single LED. And best of all, it consumes 26 µA in standby mode and 900 nA at power down mode.

The CE pin is an active-HIGH pin. When selected the nRF24L01 will either transmit or receive, depending upon which mode it is currently in. MISO that means Master in slave out pin is digital output pin. It is used to get SPI output from the nRF24L01. MOSI that means master out slave in pin is a digital input pin which is used to give SPI input to the nRF24L01. IRQ pin is an interrupt pin that can alert the master when new data is available to process. GND pin is the Ground Pin. It is usually marked by encasing the pin in a square so it can be used as a reference for identifying the other pins. CSN pin is an active-LOW pin and is normally kept HIGH. When this pin goes low, the nRF24L01 begins listening on its SPI port for data and processes it accordingly. VCC pin supplies power for the module. This can be anywhere from 1.9 to 3.9 volts. We connect it to 3.3V output from our atmega 32 microcontroller.

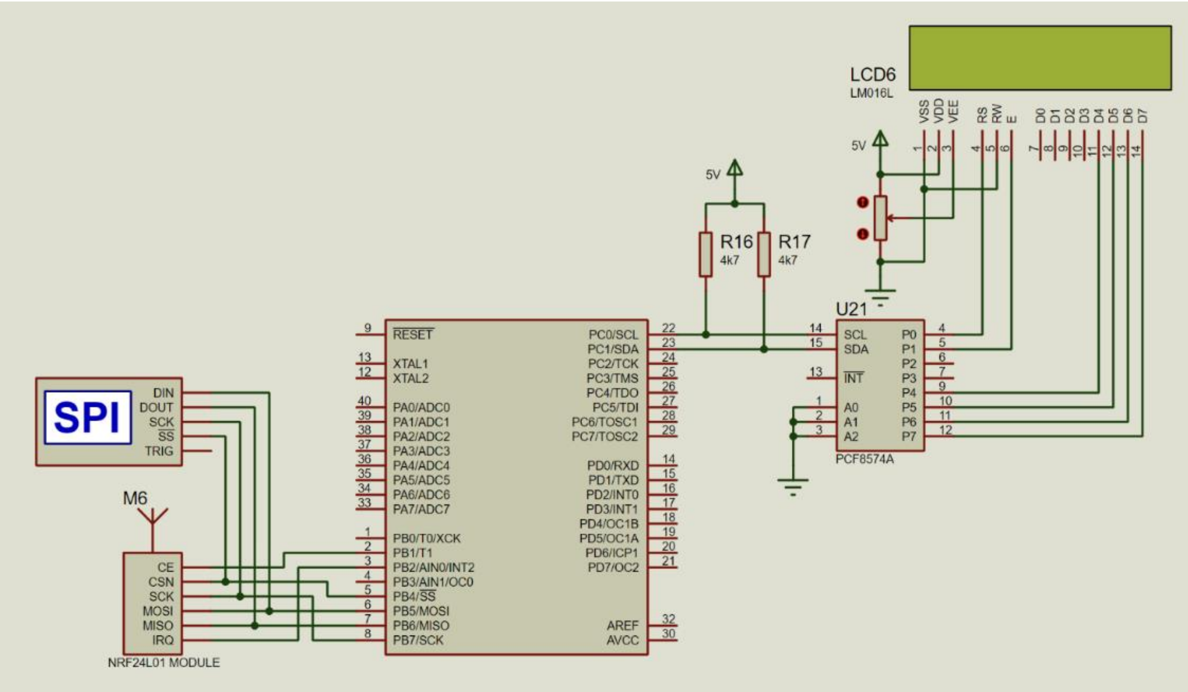

Figure 6.27 Circuit diagram nRF Transceiver

6.5.3 4x4 keypad

4x4 keypad is mainly used to get the GPS coordinates from the user. If necessary, it is used to get some configuration from the user. There are 16 push buttons divided into rows and the columns in it. The first four input lines have been connected to the four rows and the second four lines to the columns.

This 4x4 matrix keypad has 16 built-in push button contacts connected to row and column lines. All these membrane switches are connected to each other with conductive trace underneath the pad forming a matrix of 4×4 grid. Normally there is no connection between rows and columns. A microcontroller can scan these lines for a button-pressed state. In the keypad library, the Propeller sets all the column lines to input, and all the row lines to input. Then, it picks a row and sets it high. After that, it checks the column lines one at a time. If the column connection stays low, the button on the row has not been pressed. If it goes high, the microcontroller knows which row (the one it set high), and which column, (the one that was detected high when checked).

Interface has 8-pin access to 4×4 matrix. Maximum Rating is 5 V, 12.5 mA and Power is 62.5 mW. The operating temperature is 32 to 122 °F (0 to 50°C) and the dimensions of the keypad are 2.7 x 3.0 in (6.9 x 7.6 cm) and 0.78 x 3.5 in (2.0 x 8.8 cm) are the dimensions of the cable.

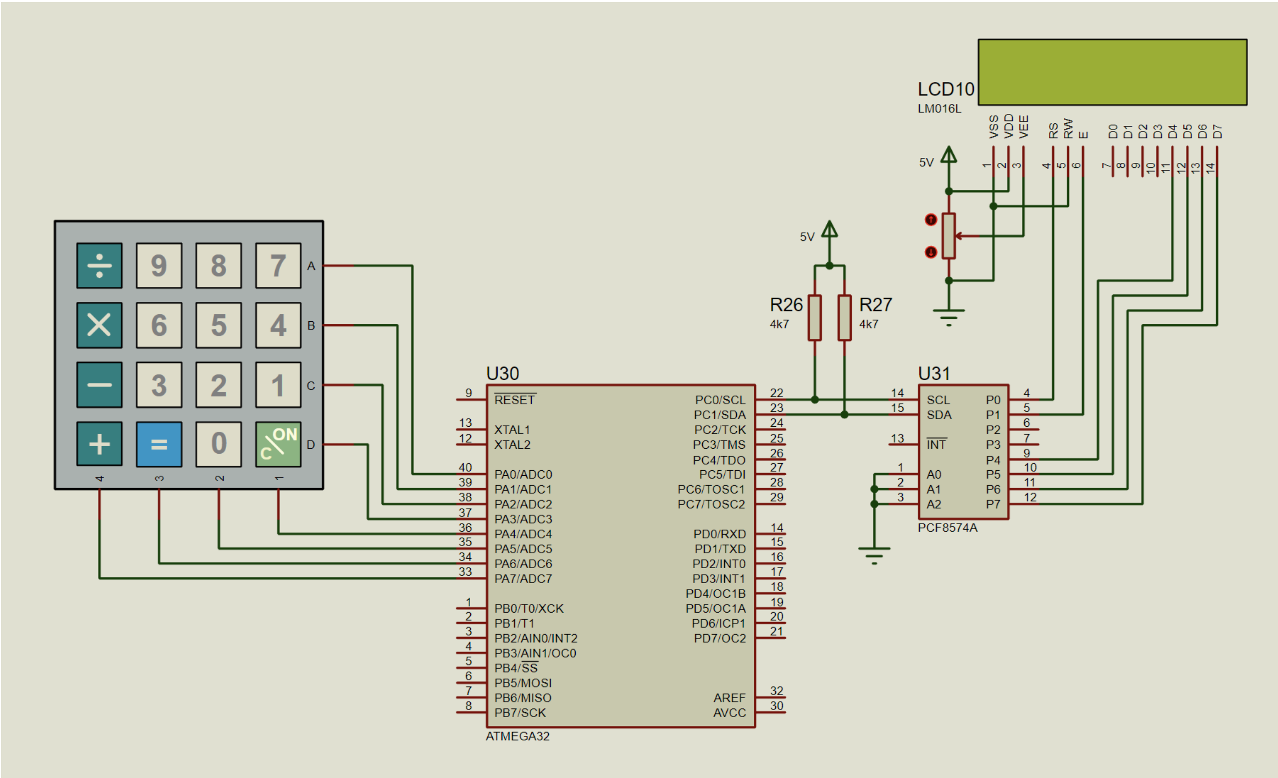

Figure 6.28 Circuit diagram - Keypad

PCB for nRF Transceiver module and 4x4 Keypad

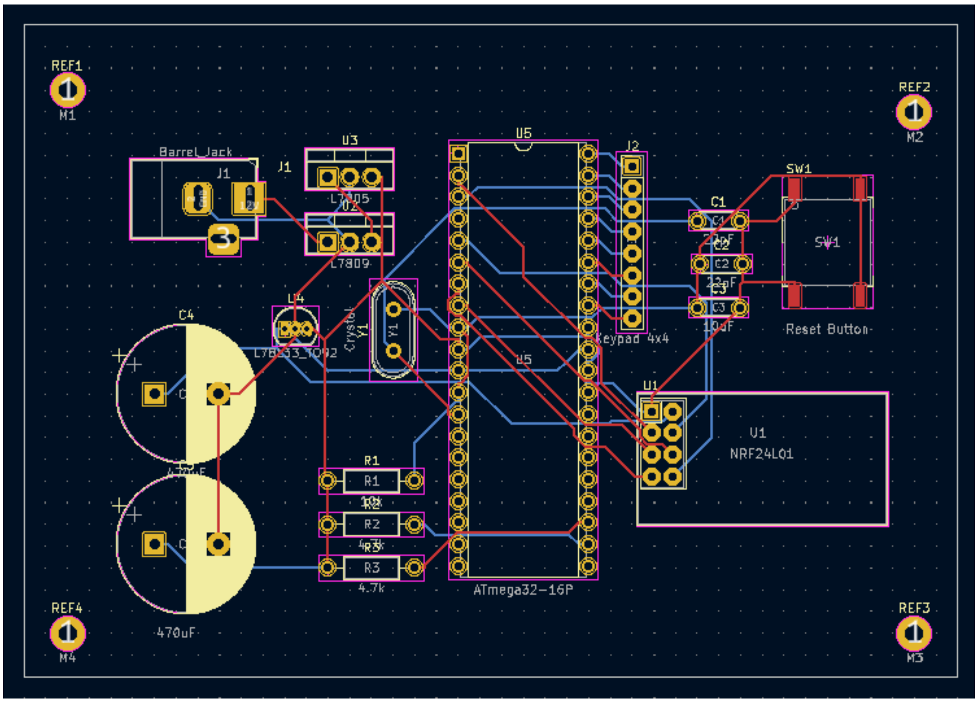

Figure 6.29 nRF transceiver and Keypad

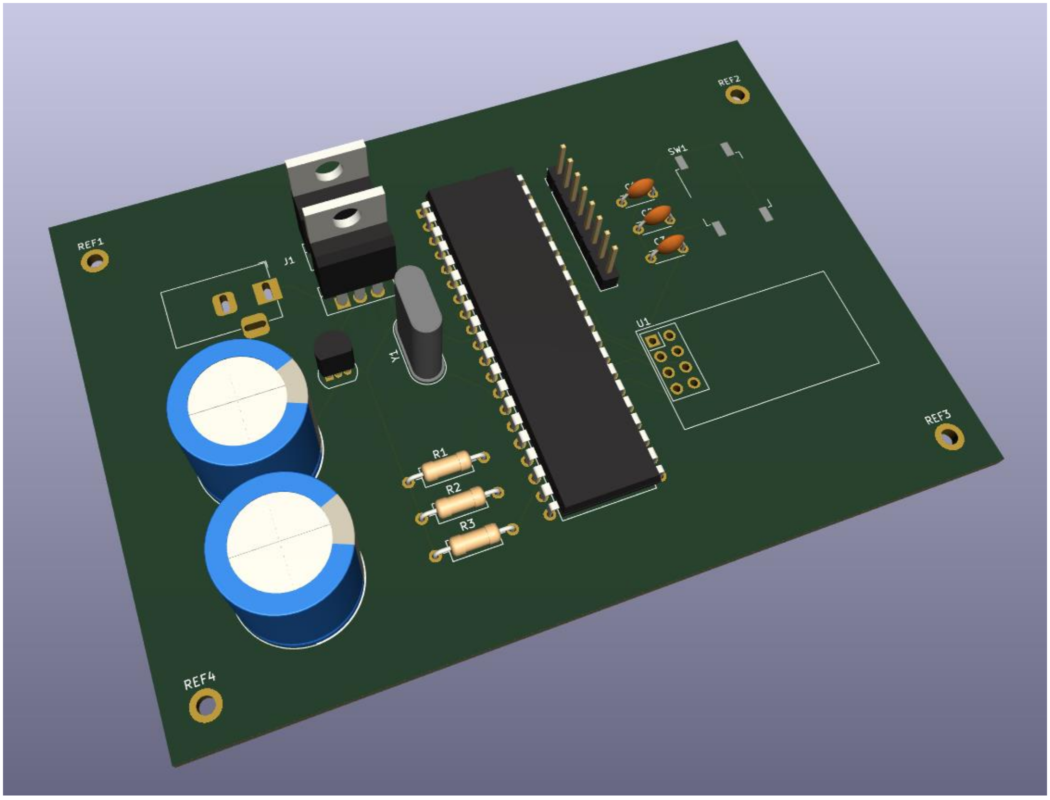

Figure 6.30 PCB - nRF transceiver and Keypad 3D

Appendix C

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