# Systems Project

Assignment 1| 102SE

Group 6
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**Abstract:**

At the outset, the report would focus on how a programmable lift monitoring system is designed. The number of people entering and leaving the lift is counted by two light dependent resistors (LDRs). The system would be programmed to give out visual and audio feedbacks. This is particularly important if the lift is overloaded.

**Introduction**:

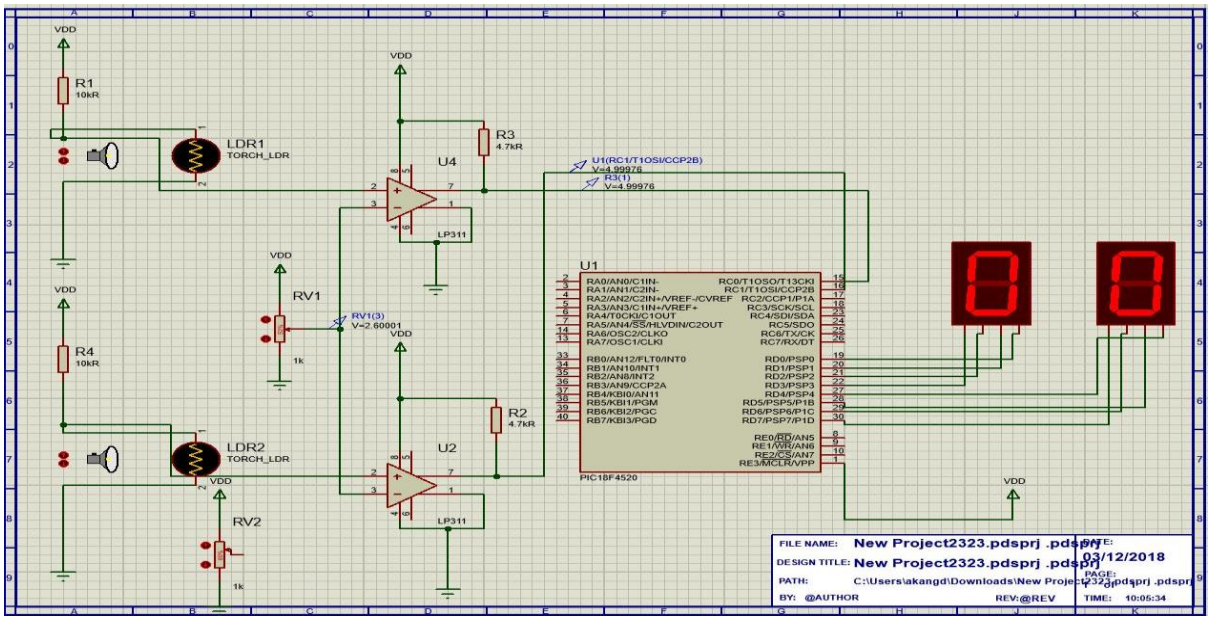
The project would apply previous knowledge gotten from working with LDR's, LED's, operational amplifiers and methods of conditioning generated signals. Lift monitoring systems are available worldwide thus making it a very important concept. It helps to transport people from low floors to high floors, vice-versa. For instance in Burj Khalifa, where the tallest building in the world is located, commuting would be difficult (En.wikipedia.org, n.d.). That building has the highest installation system. This shows the significance of the lift monitoring system.

***The hardware design and implementation:***

***1a) Sensor and signal conditioning circuit design, Proteus simulation***

Primarily, in building the sensor circuit, the sensors would be controlled using two Light Dependent Resistors (LDR). The light dependent resistors are devices whose resistance is sensitive to light. When the light intensity increases the resistivity reduces due to the fact that the electrons have gained kinetic energy and have enough force to break out of its crystalline structure. This is applied in building burglar alarms. These LDRs are positioned in such a way that one LDR accounts for a person entering the elevator and the other accounts for when a person leaves the elevator. The first LDR is positioned in front of the second LDR so that when a person enters the elevator, the light beam emitted by the first LDR is obstructed and the counter increases by one and when a person

leaves, the light beam emitted by the second LDR is obstructed and the counter decrements by one.




(Figure1: Proteus Simulation).

Also as seen in figure 1, a buffer connected as a comparator would be used. It would work as an operational amplifier with no feedback. The comparator has two inputs; a non-inverting input (V+) and an inverting input (V-). When the non-inverting input (V+) is greater than the inverting input (V-) the output is said to be positively saturated. On the other hand, when the inverting input (V-) is greater than the non-inverting input (V+) the output is said to be negatively saturated. Moreover, the chosen type of operational amplifiers is going to be an LM311 Comparator. The comparator is a single chip comparator. It can be configured to operate from either a single or dual voltage source.

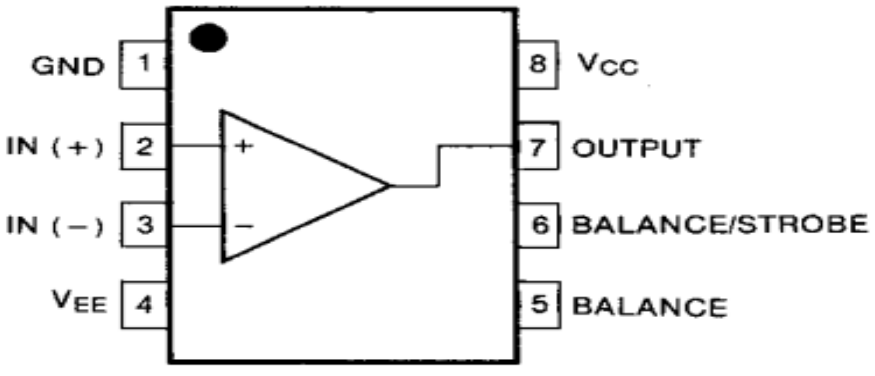



**Figure 2.Internal Block Diagram of LM311 (Fairchild Semi child 2001)**

The anode of the light emiting diode would be connected to the PIC while the cathode would be connected to a resistor in order to dissipate voltage at the resistor to avoid blowing the light emitting diode.

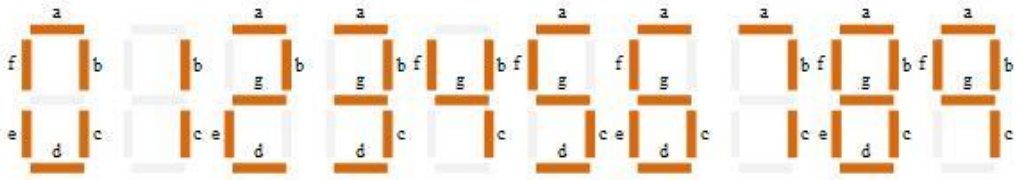



Figure 3: seven segment display

Seven segment displays would be used for implementing the output. It consits of seven light emiting diodes (thus the name), which combines to give output in the form heximals or decimals. Each of the light emiting diodes are labeled a-g as seen in figure (3), the significance of this component is that it would show the number of people in the lift at a particular time.

Moreover, the proteus simulation would be used to give visual feedback. It would also show how the components are connected together.

***1b) Analogue design implementation:***

In relation to figure (1), the circuit consists of a torch behind an LDR connected to a 10K resistor and pin 2 of the operational amplifier, pin 8 is connected to power, a 4.7k resistor and finally pin 4 and 6 being grounded. The circuit consists of two operational amplifiers and for every connection we make in the first operational amplifier, we do the same for the second operational amplifier. The pin 3 of the two operational amplifiers are connected together and this connection is now connected to a 1k potentiometer. Now this circuit is connected to a PIC micro controller which is then connected to the 7 segments which is the output that tells how many people are in the lift.

***1c) Test procedures, calibration / comparisons of simulation with practical***

***Findings/ references to Datasheets***

***Test Procedures:***

For testing the circuit, the light dependent resistors was covered, when it is done, the seven segments give a display. The potentiometer controls the output, it can control both 7- segments independently. A clip showing how the 7 segments are controlled is inserted. https://youtu.be/yG6ef3nieMc

***Calibration:***

In terms of calibration, the power source had a voltage of 5 volts. The potentiometer has a resistance of 1KΩ. The PIC has a constant frequency value of 20MHz, which makes it very fast. Thus the reason why a delay function is implemented in the code.

***Comparisons of simulation with practical findings.***

The practical implementation of the circuit required us to use a LM311 operational amplifier. On the other hand, while simulating the circuit a LP311 operational amplifier was used, this was because both operational amplifiers work similarly and for simulation processes and it was a better visually.

**2. Digital Circuit Design and Software**

## 2d) *UML design:*

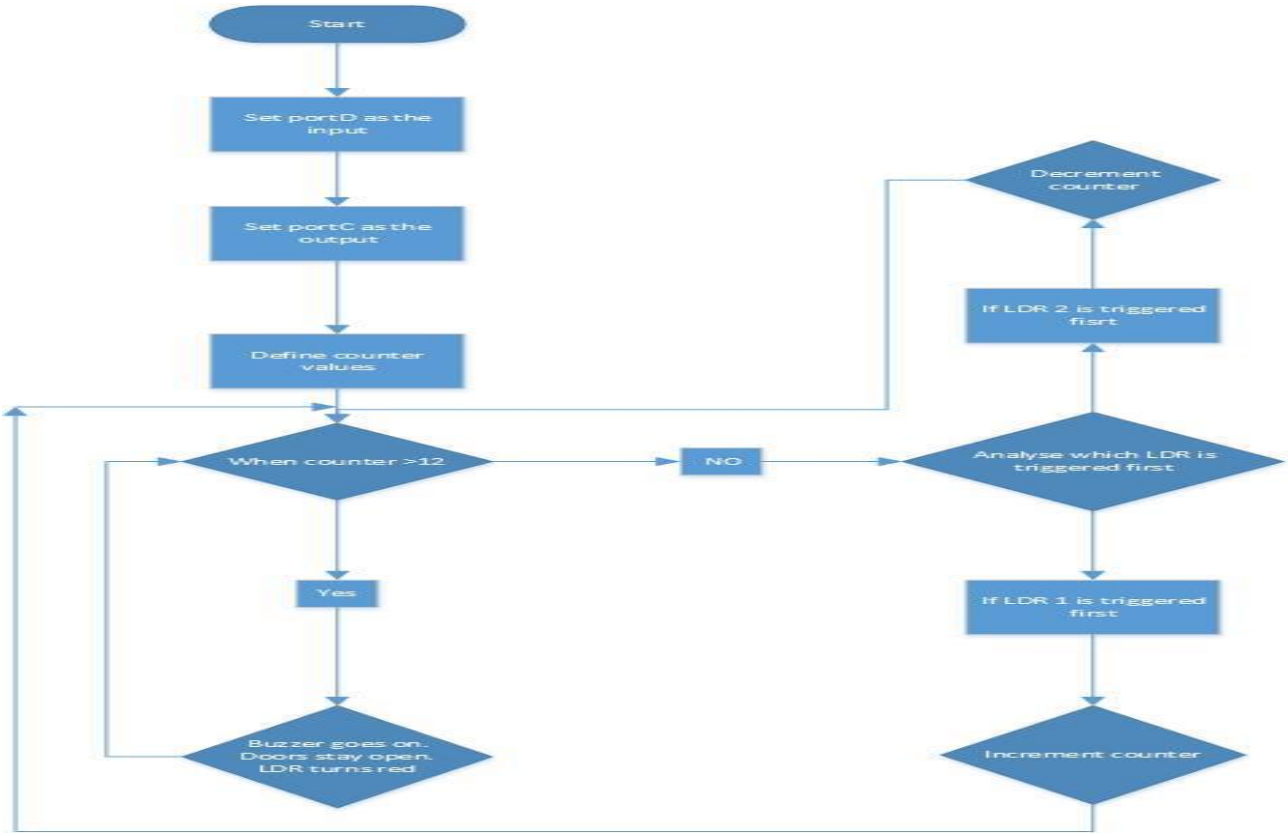



**Figure 4: Flowchart**

## 2e) *Full code listing with comments and analysis of code functions:*

; Filename: liftLDR.asm

; Date: 13/12/2018

; File Version: 1.0

;

; Author: Group 6

; Company: Coventry University

;

; Program Function : Simple Port D output counting BCD values with delay routines

;**********************************************************

; Files Required: P18F4520.INC

;**********************************************************

```
LIST P=18F4520 ; directive to define processor
#include <P18F4520.INC> ; processor specific variable definitions
;*****************************************************
; CONFIGURATION BITS
;
; Oscillator Selection and other fuse settings:
CONFIG OSC = HS ;High Speed clock
CONFIG MCLRE = ON ;MCLR enabled
CONFIG DEBUG = OFF ;Background debugger disabled, RB6 and RB7
configured as general IO
CONFIG LVP = OFF ; Low Voltage Programming OFF
CONFIG WDT = OFF ; WDT disabled
;*****************************************************
***************
; RESET VECTOR
; This code will start executing when a reset occurs.
            ORG 0x0000 ; Origin Directive set program counter to location 00
            GOTO Main ; go to start of main code
DELVAL1 EQU 0XFF
DELVAL2 EQU 0X20
DELVAL3 EQU 0X05
Main:       MOVLW 0x00
            MOVWF TRISB   ;Instruction set PORTB as Output
             MOVLW 0xFF
            MOVWF TRISC   ;Instruction set PORTC as Input
             MOVLW 0x00 ; move literal 00 into W register
             MOVWF TRISD ; copy content of W into register TRISD
                    ; above instruction set PORTD as Output
            MOVLW 0x00; Move Literal 0 into W
```

```
        MOVWF PORTD ; Move contents of W into File Reg. PortD
                    ;the previous instruction is to display 00 in the 7
segments


ENTERING BTFSS PORTC,0  ; Checks if LDR1 is 1, if yes, skip next
instruction
        GOTO LEAVING
      BTFSC PORTC,0    ; Checks if LDR1 is 1, if not, go to ldr2
       GOTO ENTERING
LDR2 BTFSS PORTC,1  ;Check if LDR2 is 1, if it is, skips next instruction
        GOTO LDR2
      BTFSC PORTC,1     ;Check if LDR2 is 1, if not, goes to increment
      GOTO INCREMENT
      GOTO ENTERING
                    ;above instruction, Ldr2 and Entering, check if people
are coming inside the lift

LEAVING BTFSS PORTC,1 ;Check if LDR2 is 1 if it is it skips next
instruction
        GOTO ENTERING
     BTFSC PORTC,1      ;Check if LDR2 is 1, if not, goes to LDR1
     GOTO LDR1
     GOTO TLEAVING

LDR1    BTFSS PORTC,0  ;Checks if  LDR1 is 1 if it is it skips next instruction
          GOTO LDR1
        BTFSC PORTC,0  ;Check if LDR1 is 1 if, not goto decrement
        GOTO DECREMENT
```

```
        GOTO ENTERING
                                ;above instruction, leaving and ldr1, check if people
are leaving the lift

INCREMENT
 CALL DELAY
 LOOP
 INCF PORTD ; Increment contents of Port D
MOVF PORTD,W ; Move contents of Port D File Register Into W
DAW ; Decimally adjust contents of the Working Register
MOVWF PORTD ; Move adjusted contents of W into Port D
MOVLW 0xC   ; Move 12 into Work Register
CPFSLT PORTD ;Compare with contents of PORTD
GOTO ALERT  ;IF  PORTD is over 12 go to alert
GOTO ENTERING

DECREMENT
 CALL DELAY ; Calling Delay
 LOOP1
 DECF PORTD ; Increment contents of Port D
MOVF PORTD,W ; Move contents of Port D File Register Into W
MOVWF PORTD ; Move adjusted contents of W into Port D
GOTO ENTERING

 ALERT
 MOVLW 0xFF  ;Move Hexadecimal value FF into the work Register
 MOVWF TRISB ; Move value to PortB and turn on red LEDs
                ; above instruction is only executed when the inappropriate number
of people is inside the lift – greater than 12
```

```
; Delay Routine follows below
DELAY MOVLW 0XFF ; Move Literal value 0xFF into W (first delay value)
        MOVWF DELVAL1 ; Store this value in location DELVAL1
        MOVLW 0X10 ; Move Literal value 0x10 into W (Delay value 3)
        MOVWF DELVAL3 ; Store into DELVAL3 location
REPEAT MOVLW 0XFF ; Move Literal value 0xFF into W
        MOVWF DELVAL2 ; Move contents of W (FF) into DELVAL2
HERE NOP ; No Operation
        DECF DELVAL2,F ; Decrement contents of DELVAL2
        BNZ HERE ; If has not reached zero branch to location HERE
        DECF DELVAL1,F ; Decrement contents of DELVAL1
        BNZ REPEAT ; If not zero branch to location REPEAT
        DECF DELVAL3 ; Decrement contents of DELVAL3
        BNZ HERE ; If not zero go to location HERE
        RETURN ; Return from Subroutine to the main program
;**********************************************************************
***************
; End of program
END ; End Directive
```

***Code Analysis:***

In order to follow the instructions given regarding the lift and the specific functionalities of the LDRs, the group had to write a code in order to check if Ldr1 or Ldr2 has been broken first. The increment or decrement setting depended on which LDR was broken. According to the activity, if LDR1 is triggered before LDR2, the counter should be incremented. On the other hand, if LDR2 has been broken first followed by LDR1, the contents of counter should be decremented.

Also, it was important to define the inputs and the outputs of the circuit. The group decided to use port D as input and Port C as the output respectively, any changes in the input should affect the output, the reason why the comparator circuits when connected in the input and the 7 segments in the output.
After defining the input and output and setting the initial value 0x00 displayed on the counter, the next step was to check which LDR has been broken first in order to increment or decrement. We had chosen the value 1 as the constant value and 0 for when the LDRs were triggered. Therefore, the value of the LDR1 was check if it was 0 and then 1 and the next instruction would be to check the same for LDR2. If both cases were true, the values of the counter would be incremented. In order to decrement the values of the counter, we would check the values of the LDR2 and then the values of LDR1. The reason why we have chosen to follow this procedure was to be sure of which LDR was triggered.
Moreover, another way of doing it, would be to define a register for each LDR and compare their values before incrementing or decrementing. If neither of the LDRs were broken, the code would continually check LDR1 and LDR2 until one of them is broken. One of the problems that the group encountered was to split the values displayed on the counter into two (example, from 9 to 10). With the purpose of overcoming this issue, the DAW command was used.
This command adjusts the decimal values in the working register. Another problem was to solve the same problem for decrement (for example from 10 to 9 which instead of displaying 09, it was displaying 0F). Since it is not possible to use DAW for decrement, we had to subtract 6 from the register so we could overcome it. In addition, the PIC was slower than the analogue; therefore since the frequency advisable was 20MHz, a Delay routine was used in the code to slow it down.
Lastly, since the appropriate number of people inside the lift was less or equal than twelve, an alert label was also written. During incrementing action, we

compared the values of the counter to 0x12 on the working register. If the counter was bigger than twelve, the alert command would be started, triggering the LEDs. If the code was to be implemented in an actual lift, the doors would not close and the buzzer would go on.

***2f) Overall system Proteus simulation***

The simulated test results for the circuit diagram shown in figure 1 is embedded in the URL; https://youtu.be/T35OaEnQrHk

***2g) Overall system practical implementation and test results***

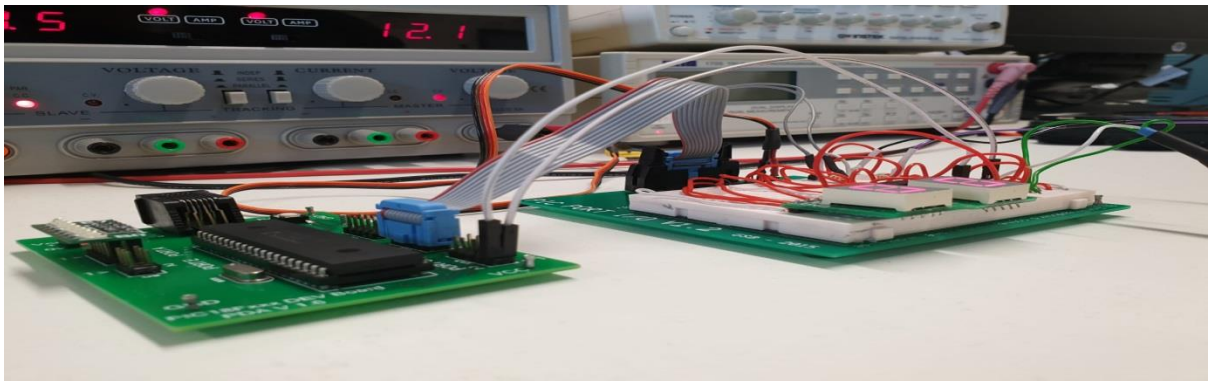


**Figure 5. Circuit Diagram**

The circuit was built as shown in Figure 5. After building the circuit, each component of the circuit was tested and checked for response from the seven segment to see if it was working. In other to check if it was working, the LDR was completely with covered obstructing it from light, then the seven segment was checked and it turned on. There were no increments or decrements because the code wasn't load yet. The 7 segments were connected alongside each other because 9 is highest single digit number an individual seven segment can show so placing them alongside each other enables you to have two digit numbers.

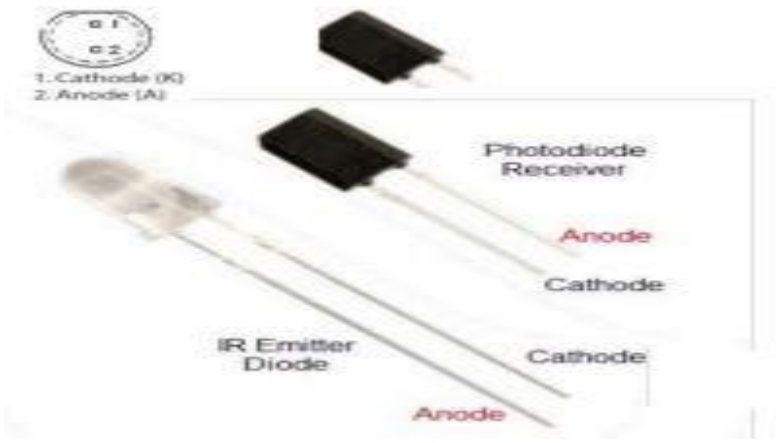
## 3. Product Design

***3a) Concept design, system implementation and application, discussion of possible issues in its implementation)***

The circuit was designed to give out visual feedbacks using light emitting diodes. The concept design implemnted is shown in Figure 5. Moreover, the system has two LEDs that account for the availability of space in the elevator, the green LED is activated when the elevator has space for individuals while the red LED is activated when there is no more space left in the elevator, this can be called the visual feedback. There can also be an audio feedback when the elevator is full. Also while implementing the circuit the 7 segment was not giving out outputs, the problem was troubleshot by using a digital multi meter probe to check the output of the operational amplifier at varying light levels. The light levels varied which confirmed that the comparator was working. The light dependent resistors were also replaced but the output was the same. Thus the hardware design worked well.

*3b)* ***Enhancing system functionality by the provision of connectivity and Other possible features.***

In the same line, a way of improving the functionality of the system is by introducing a better responsive system like an infrared emitting diode and a corresponding IR photodiode. The system would improve due to the fact that both components are optically and mechanically matched and ambient light would not affect it.



` Figure 6 :( Coventry University, n.d.)

**Conclusion**:

***Chukwuemeka Horsfall (8511968)***

In this project, I was mostly associated with the hardware part of things; I helped in the simulation of the circuit and the building of the circuit in the bread board. I worked with one of my group mates to build the hardware; we designed the simulation and built the circuit. This project improved by understanding of operational amplifiers and optical signalling systems. I can confidently say that my hardware designing abilities have improved drastically compared to when I started this project. Knowledge acquired in previous sessions was very important and helped us accomplish tasks faster, different activities were split amongst us and we were able to carryout the task effectively.

***David Basil Akang (8251628)***

For the concept, I worked in a team of two building the hardware and connecting the components together. Also based on the learning outcomes, I was able to work in a team to build and implement a concept to solve a problem. For my role, in the team I had to refer to the data sheets on various components i.e. operational amplifiers, to be able to connect them. Tests were undergone to confirm that the individual components were working, the circuit at the end of the day did not give the required output. The concept was first tackled by creating a flowchart, drafting sample codes and designing the hardware. I have been able to apply previous knowledge derived from working with these components in previous weeks.

***Edson Casimiro Teixeira (9074260)***

Personally, although the code was complicated I learned a lot from it. The group spent 3 weeks trying to write the code and make it to work properly, and we have failed so many times but, as every engineer, we did not give up, we kept

trying in order to achieve our goals. The code gave me a better insight into how a minimal change in the code could alter the whole circuit and make it work in a whole different way. It also taught me not to overthink in order to overcome a problem and that there are many other ways of solving the same problem. I become more familiar with assembly code and its various commands and how they specifically work.

This activity was a great experience due to the fact that I had an opportunity to work in a group and to become more knowledgeable about how engineers combine idea and think differently in order to achieve a common goal. I am certain that the knowledge gained during this experiment will be required in the near future and, if my true goal is to succeed, I will have to use and improve the skills I have used to finalise the experiment.

List of References:

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