Integrated Term Project
ME - 5643

Done By:
Rakshith Asokan
Rezwana Uddin

Project Title

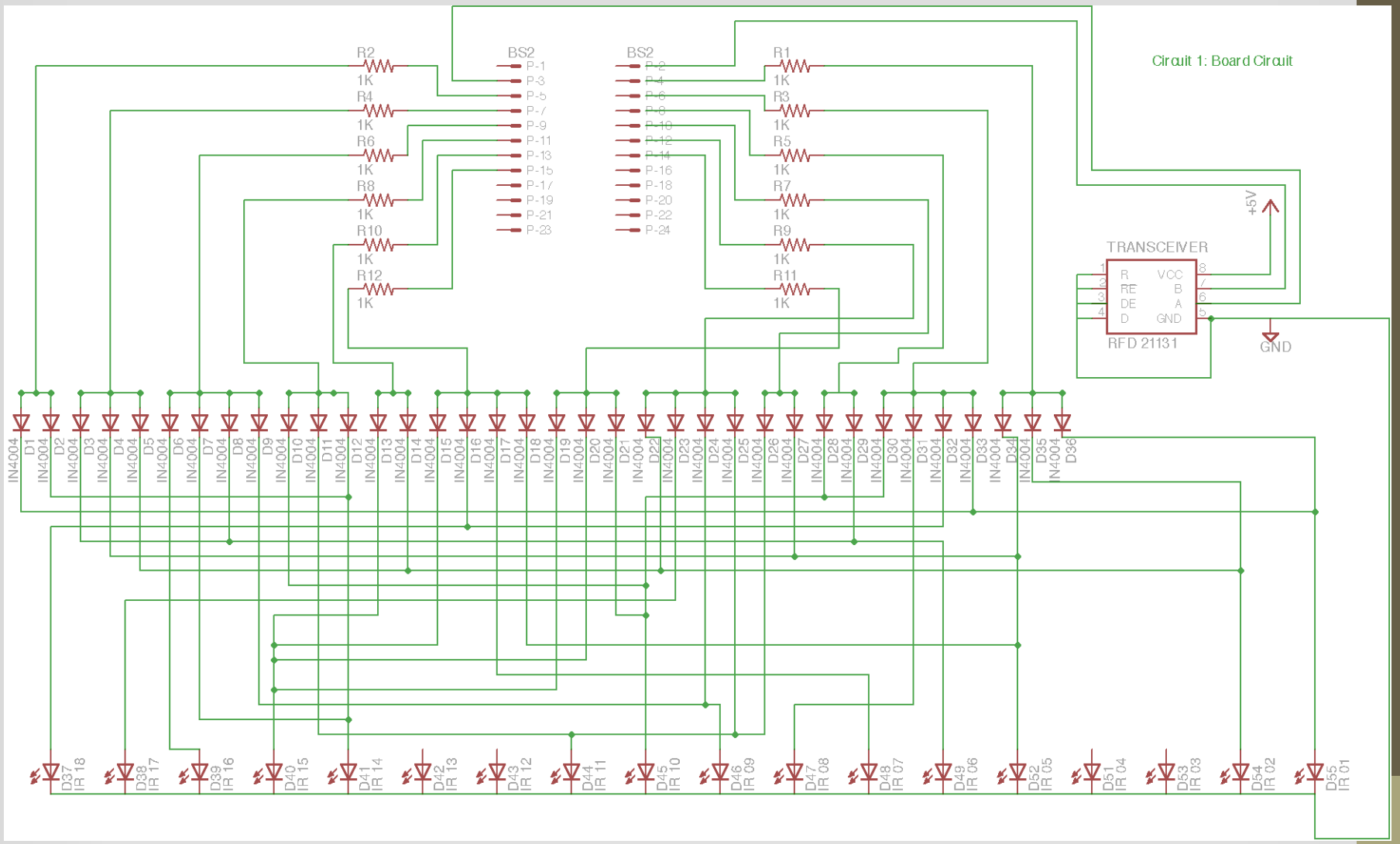
Automated Guided Vehicle

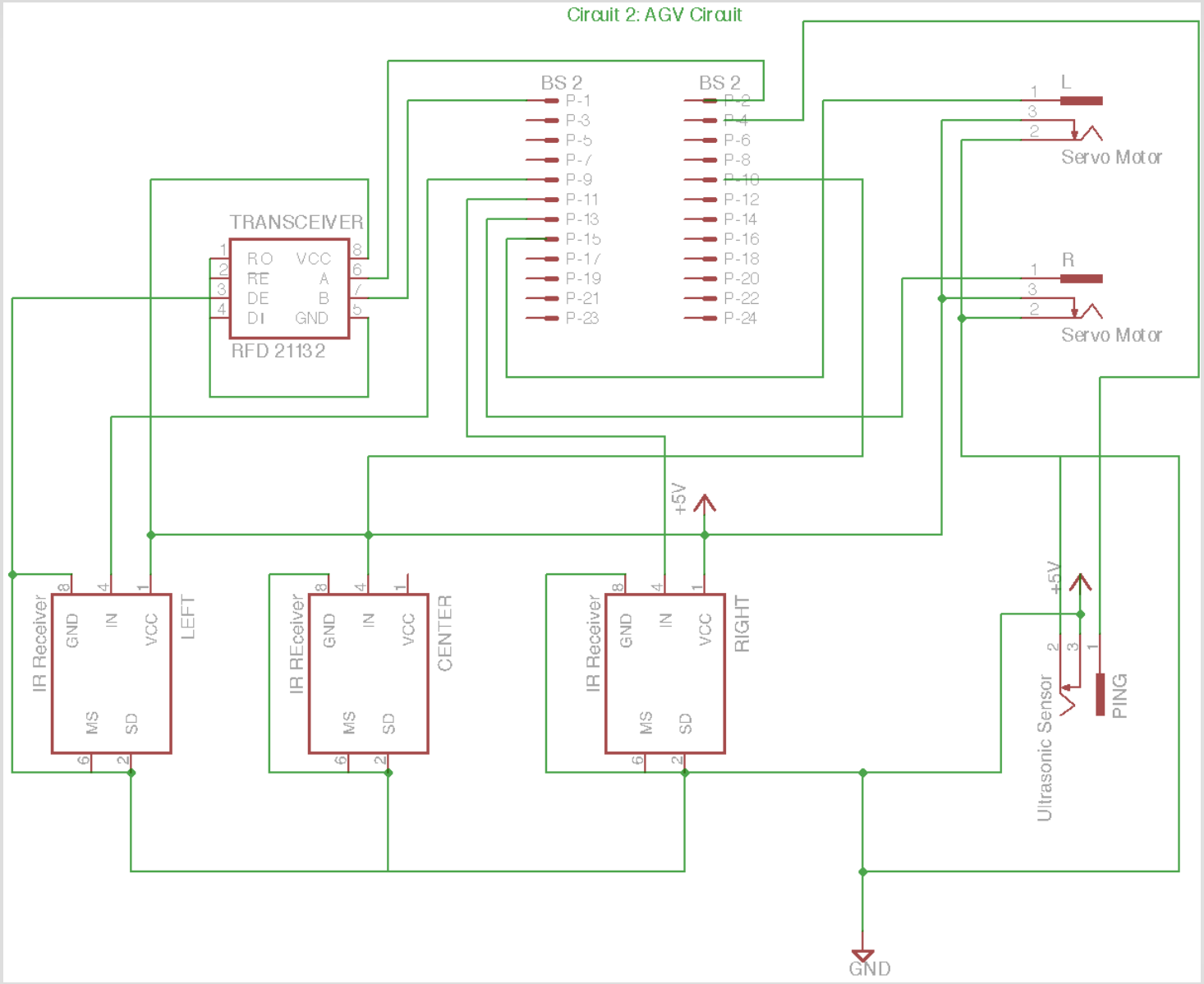
Project Goals

- To develop and construct a prototype of a low cost, user friendly, automated guided vehicle (AGV) to contribute to an efficient material handling system in a small-scale industry.
- To communicate wirelessly to and from the AGV from the base station.
- The AGV would be guided with the help of IR emitters planted in the ground that would be detected by the on-board IR receivers.
- Instructions sent to the robot has to be executed and synchronized with the base station.

Construction

- Standard Components
- BOE – Bot Kit [From Parallax]
  - Servo
  - LCD
  - IR Receiver
- IR Emitters, Resistors, Diodes and Wires [Radio Shack]


Circuit 1: Board Circuit
R2
1K
R4
1K
R6
1K
R8
1K
R10
1K
R12
1K
R1
1K
R3
1K
R5
1K
R7
1K
R9
1K
R11
1K
BS2
P-1
P-3
P-5
P-7
P-9
P-11
P-13
P-15
P-17
P-19
P-21
P-23
BS2
P-2
P-4
P-6
P-8
P-10
P-12
P-14
P-16
P-18
P-20
P-22
P-24
TRANSCEIVER
R
RE
DE
D
VCC
B
A
GND
RFD 21131
+5V
GND
IN4004
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
D19
D20
D21
D22
D23
D24
D25
D26
D27
D28
D29
D30
D31
D32
D33
D34
D35
D36
D37 IR 18
D38 IR 17
D39 IR 16
D40 IR 15
D41 IR 14
D42 IR 13
D43 IR 12
D44 IR 11
D45 IR 10
D46 IR 09
D47 IR 08
D48 IR 07
D49 IR 06
D52 IR 05
D51 IR 04
D53 IR 03
D54 IR 02
D55 IR 01


Circuit 2: AGV Circuit
BS 2
P-1
P-3
P-5
P-7
P-9
P-11
P-13
P-15
P-17
P-19
P-21
P-23
BS 2
P-2
P-4
P-6
P-8
P-10
P-12
P-14
P-16
P-18
P-20
P-22
P-24
L
Servo Motor
R
Servo Motor
TRANSCEIVER
RO
RE
DE
DI
VCC
A
B
GND
RFD 21132
+5V
IR Receiver
GND
IN
VCC
MS
SD
LEFT
IR REceiver
CENTER
IR Receiver
RIGHT
+5V
Ultrasonic Sensor
PING
GND

Working - I

- The AGV is retrieved from the charging dock and sent to the first workstation.
- IR emitters fitted in the ground define the path to the first workstation.
- At the workstation the AGV awaits instructions from the user.
- IR emitters define the next path to be taken by the AGV to the next workstation.

Working - II

- The path can be defined by entering the workstation number and BS2 will reflect the shortest route by exciting the corresponding IR emitters.
- The shortest route is predefined by diode logics.
- The AGV will move to the next workstation and await instructions.
- At the end of the shop floor shift, the AGV will be triggered to return to its charging dock.
- As a safety precaution, the AGV would stall in place if there were an obstacle ahead of it.

Key Features of the Project

- Aimed at developing a low cost material handling equipment.
- Incorporates wireless devices to send/receive information wirelessly from the BS2 on the AGV.
- The path is defined using logics developed using electrical components that are controlled by another BS2.
- Incorporating safety feature to stall immediately.
- Components of factory standards have been incorporated.

Cost Analysis

- Cost to make 1 AGV - $373.12
- Cost when mass produced - $285.09
- Savings – 23.59%

Robot Logic

1	1	1	0
r	*c*	*l*	x

```
CASE 2, 8
        pulseleft=768
        pulseright=731
        robot_state=1
        DEBUG "Moving forward", CR
        SEROUT 3, 84, [DEC1 next_station, 13, "Moving forward"]
```

Robot Logic

```
CASE 14
        IF robot_state>0 THEN
          pulseleft=768
          pulseright=731
          'SEROUT 3, 84, [22, 12]
          'SEROUT 3, 84, [DEC1 next_station, 13, "Moving forward"]
        ENDIF
```

Robot Logic

```
CASE 12
    'turn left
    pulseleft=731
    pulseright=731
    robot_state=2

    SEROUT 3, 84, [DEC1 next_station, 13, "Turning left"]
    DEBUG "Turning left", CR
```

Robot Logic

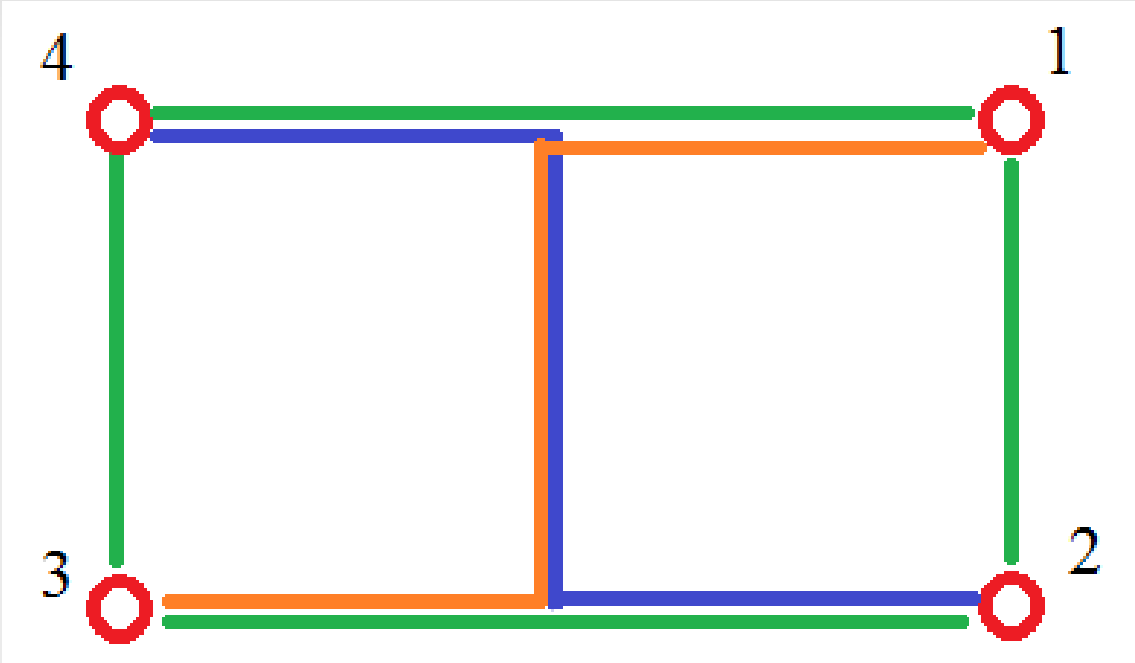
CASE 6

```
'turn right
 pulseleft=768
 pulseright=768
 robot_state=3
 DEBUG "Turning right", CR
 'SEROUT 3, 84, [22, 12]
 SEROUT 3, 84, [DEC1 next_station, 13, "Turning right"]
```

Robot Logic

```
CASE 10
        pulseleft=750
        pulseright=750
       IF robot_state>0 THEN
         'SEROUT 3, 84, [22, 12]
         SEROUT 3, 84, [DEC1 next_station, 13,
"Stopping..."]
       ELSE
         SEROUT 3, 84, [22, 12]
         SEROUT 3, 84, [DEC1 next_station, 13,
"Stopped"]
       ENDIF
        robot_state=0
        DEBUG "Stopping", CR
        curr_station=next_station
        GOTO Arrived
     ENDSELECT
```

Board Logic



NEtoNW:

```
DO
   FREQOUT 5, 5, 38500
   SERIN BaseIN, 84, 20, NEtoNW, [curr_station]
  LOOP UNTIL curr_station=next_station
  GOTO Confirm
```

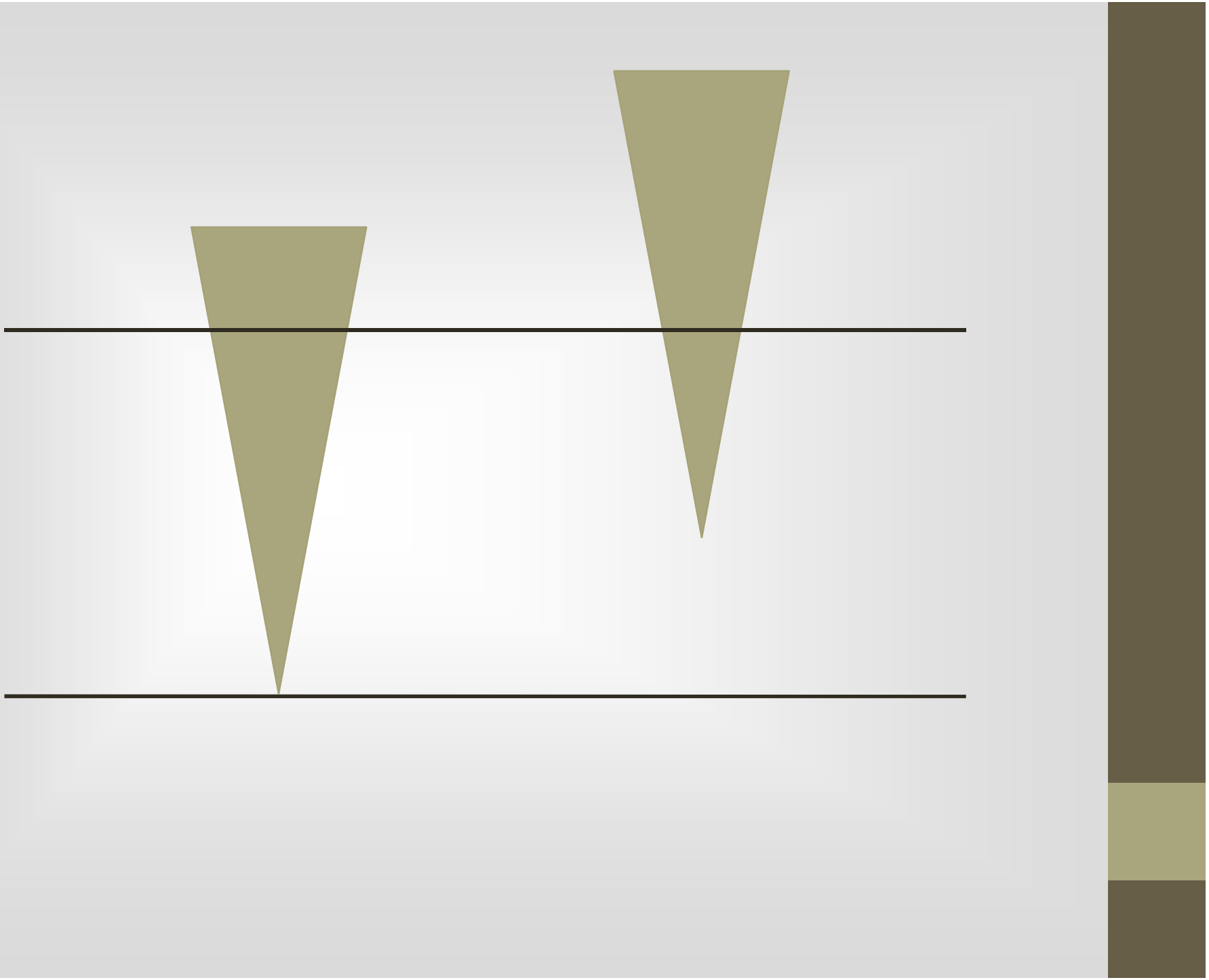
Board Logic

```
NEtoSE:
  DO
    'Light up the correct path
    FREQOUT 4, 5, 38500
    SERIN BaseIN, 84, 20, NEtoSE, [curr_station]

   LOOP UNTIL curr_station=next_station '
   DEBUG "Arrived at: ", DEC curr_station, CR
  GOTO Confirm
```

Problems Incurred

- Leak in RF Emitters
- Detection problems in RF Receivers
- Timing difference between the emitter and the receiver
- RF Transceivers circuitry
- SERIN / SEROUT
- Breadboard Problems
- Grounding Problems



SERIN

```
DO
   FREQOUT 5, 5, 38500
   SERIN BaseIN, 84, 20, NEtoNW, [curr_station]

LOOP UNTIL curr_station=next_station
  GOTO Confirm
```

Scope

- Can be integrated to SAP.
- Modules such as Wi-Fi and GPS can be added.
- Attachments such as end effectors can be added.
- High powered Microprocessor can be used.
- Can be extended to the entire industry having many units.

QUESTIONS?

Demo!