

# COE 538 - Robot Guidance Challenge Final Report

|             |    |
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| Lab Section | 02 |
|-------------|----|

|              |                |
|--------------|----------------|
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## Code Explanation

```

Entry:      ORG    $4000
_Startup:
            LDS    #$4000
            JSR    initPORTS
            JSR    initAD
            JSR    initLCD
            JSR    clrLCD

            JSR    initTCNT

            CLI
            LDY    #msg1
            JSR    putsLCD

            LDAA   #$8A
            JSR    cmd2LCD
            LDY    #msg2
            JSR    putsLCD

            LDAA   #$C0
            JSR    cmd2LCD
            LDY    #msg3
            JSR    putsLCD

            LDAA   #$C7
            JSR    cmd2LCD
            LDY    #msg4
            JSR    putsLCD

main        JSR    UPDT_READING
            JSR    UPDT_DISPL
            LDAA   CRNT_STATE
            JSR    DISPATCHER
            BRA    main

```

This is the startup code and the main code. The startup code initializes several functions which the eebot requires. The main code runs the same 4 lines repeatedly to execute subsections which carry out the code.

|             |      |             |  |             |       |                          |
|-------------|------|-------------|--|-------------|-------|--------------------------|
| DISPATCHER  | CMPA | #START      |  | FWD_ST      | PULD  |                          |
|             | BNE  | NOT_START   |  |             | BRSET | PORTAD0,\$04,NO_FWD_BUMP |
|             | JSR  | START_ST    |  |             | LDAA  | SEC_PTH_INT              |
|             | RTS  |             |  |             | STAA  | NEXT_D                   |
| NOT_START   | CMPA | #FWD        |  |             | JSR   | INIT_REV                 |
|             | BNE  | NOT_FORWARD |  |             | MOVB  | #REV,CRNT_STATE          |
|             | JMP  | FWD_ST      |  |             | JMP   | FWD_EXIT                 |
| NOT_FORWARD | CMPA | #RT_TRN     |  | NO_FWD_BUMP | BRSET | PORTAD0,\$08,NO_REV_BUMP |
|             | BNE  | NOT_RT_TRN  |  |             | JMP   | INIT_BK_TRK              |
|             | JSR  | RT_TRN_ST   |  |             | MOVB  | #BK_TRK,CRNT_STATE       |
|             | RTS  |             |  |             | JMP   | FWD_EXIT                 |
| NOT_RT_TRN  | CMPA | #LT_TRN     |  | NO_REV_BUMP | LDAA  | SENS_C                   |
|             | BNE  | NOT_LT_TRN  |  |             | BEQ   | NO_RT_INTXN              |
|             | JSR  | LT_TRN_ST   |  |             | LDAA  | NEXT_D                   |
|             | RTS  |             |  |             | PSHA  |                          |
| NOT_LT_TRN  | CMPA | #REV        |  |             | LDAA  | PRI_PTH_INT              |
|             | BNE  | NOT_REVERSE |  |             | STAA  | NEXT_D                   |
|             | JSR  | REV_ST      |  |             | JSR   | INIT_RT_TRN              |
|             | RTS  |             |  |             | MOVB  | #RT_TRN,CRNT_STATE       |
| NOT_REVERSE | CMPA | #BK_TRK     |  |             | JMP   | FWD_EXIT                 |
|             | BNE  | NOT_BK_TRK  |  | NO_RT_INTXN | LDAA  | SENS_B                   |
|             | JMP  | BK_TRK_ST   |  |             | BEQ   | NO_LT_INTXN              |
| NOT_BK_TRK  | CMPA | #SBY        |  |             | LDAA  | SENS_A                   |
|             | BNE  | NOT_SBY     |  |             | BEQ   | LT_TURN                  |
|             | JSR  | SBY_ST      |  |             | LDAA  | NEXT_D                   |
|             | RTS  |             |  |             | PSHA  |                          |
| NOT_SBY     | NOP  |             |  |             | LDAA  | PRI_PTH_INT              |
| DISP_EXIT   | RTS  |             |  |             | STAA  | NEXT_D                   |
|             |      |             |  |             | BRA   | NO_SHFT_LT               |
|             |      |             |  |             | LDAA  | NEXT_D                   |
|             |      |             |  |             | PSHA  |                          |
|             |      |             |  |             | LDAA  | SEC_PTH_INT              |
|             |      |             |  |             | STAA  | NEXT_D                   |
|             |      |             |  |             | JSR   | INIT_LT_TRN              |
|             |      |             |  |             | MOVB  | #LT_TRN,CRNT_STATE       |
|             |      |             |  |             | JMP   | FWD_EXIT                 |
|             |      |             |  | NO_LT_INTXN | LDAA  | SENS_C                   |
|             |      |             |  |             | BEQ   | NO_SHFT_RT               |
|             |      |             |  |             | JSR   | PORTON                   |
|             |      |             |  |             | LDD   | COUNT2                   |
|             |      |             |  |             | CPD   | #INC_DIS                 |
|             |      |             |  |             | BLO   | RT_FWD_DIS               |
|             |      |             |  |             | JSR   | INIT_FWD                 |
|             |      |             |  |             | JMP   | FWD_EXIT                 |
|             |      |             |  | RT_FWD_DIS  | LDAA  | SENS_C                   |
|             |      |             |  |             | BEQ   | NO_SHFT_LT               |
|             |      |             |  |             | JSR   | STARON                   |
|             |      |             |  |             | LDD   | COUNT1                   |
|             |      |             |  |             | CPD   | #INC_DIS                 |
|             |      |             |  |             | BLO   | LT_FWD_DIS               |
|             |      |             |  |             | JSR   | INIT_FWD                 |
|             |      |             |  |             | JMP   | FWD_EXIT                 |
|             |      |             |  | NO_SHFT_RT  | LDAA  | SENS_C                   |
|             |      |             |  |             | BEQ   | NO_SHFT_LT               |
|             |      |             |  |             | JSR   | STARON                   |
|             |      |             |  |             | LDD   | COUNT1                   |
|             |      |             |  |             | CPD   | #FWD_DIS                 |
|             |      |             |  |             | BLO   | FWD_STR_DIS              |
|             |      |             |  |             | JSR   | INIT_FWD                 |
|             |      |             |  |             | JMP   | FWD_EXIT                 |
|             |      |             |  | NO_SHFT_LT  | JSR   | STARON                   |
|             |      |             |  |             | JSR   | PORTON                   |
|             |      |             |  |             | LDD   | COUNT1                   |
|             |      |             |  |             | CPD   | #FWD_DIS                 |
|             |      |             |  |             | BLO   | FWD_STR_DIS              |
|             |      |             |  |             | JSR   | INIT_FWD                 |
|             |      |             |  |             | JMP   | FWD_EXIT                 |
|             |      |             |  | FWD_EXIT    | JMP   | main                     |

This is the Dispatcher code. This helps the eebot identify which process to run next. The code beside the Dispatcher tells the eebot to follow the black line which alternates between different states of rotation.

|            |       |                     |
|------------|-------|---------------------|
| START_ST   | BRCLR | PORTAD0,\$04,NO_FWD |
|            | JSR   | INIT_FWD            |
|            | MOVB  | #FWD,CRNT_STATE     |
|            | BRA   | START_EXIT          |
| NO_FWD     | NOP   |                     |
| START_EXIT | RTS   |                     |

This is the start state. When the front bumper is pressed, the bot will begin to start and run.

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|            |      |                    |               |      |                    |
|------------|------|--------------------|---------------|------|--------------------|
| REV_ST     | LDD  | COUNT1             | RT_TRN_ST     | LDD  | COUNT2             |
|            | CPD  | #REV_DIS           |               | CPD  | #STR_DIS           |
|            | BLO  | REV_ST             |               | BLO  | RT_TRN_ST          |
|            | JSR  | STARFWD            |               | JSR  | STAROFF            |
|            | LDD  | #0                 |               | LDD  | #0                 |
|            | STD  | COUNT1             |               | STD  | COUNT2             |
| REV_U_TRN  | LDD  | COUNT1             | RT_TURN_LOOP  | LDD  | COUNT2             |
|            | CPD  | #UTRN_DIS          |               | CPD  | #TRN_DIS           |
|            | BLO  | REV_U_TRN          |               | BLO  | RT_TURN_LOOP       |
|            | JSR  | INIT_FWD           |               | JSR  | INIT_FWD           |
|            | LDAA | RETURN             |               | LDAA | RETURN             |
|            | BNE  | BK_TRK_REV         |               | BNE  | BK_TRK_RT_TRN      |
|            | MOVE | #FWD,CRNT_STATE    |               | MOVE | #FWD,CRNT_STATE    |
|            | BRA  | REV_EXIT           |               | BRA  | RT_TRN_EXIT        |
| BK_TRK_REV | JSR  | INIT_FWD           | BK_TRK_RT_TRN | MOVE | #BK_TRK,CRNT_STATE |
|            | MOVE | #BK_TRK,CRNT_STATE |               |      |                    |
| REV_EXIT   | RTS  |                    | RT_TRN_EXIT   | RTS  |                    |

  

|               |      |                    |
|---------------|------|--------------------|
| LT_TRN_ST     | LDD  | COUNT1             |
|               | CPD  | #STR_DIS           |
|               | BLO  | LT_TRN_ST          |
|               | JSR  | PORTOFF            |
|               | LDD  | #0                 |
|               | STD  | COUNT1             |
| LT_TURN_LOOP  | LDD  | COUNT1             |
|               | CPD  | #TRN_DIS           |
|               | BLO  | LT_TURN_LOOP       |
|               | JSR  | INIT_FWD           |
|               | LDAA | RETURN             |
|               | BNE  | BK_TRK_LT_TRN      |
|               | MOVE | #FWD,CRNT_STATE    |
|               | BRA  | LT_TRN_EXIT        |
| BK_TRK_LT_TRN | MOVE | #BK_TRK,CRNT_STATE |
| LT_TRN_EXIT   | RTS  |                    |

  

|            |       |                         |
|------------|-------|-------------------------|
| BK_TRK_ST  | PULD  |                         |
|            | BRSET | PORTAD0,\$08,NO_BK_BUMP |
|            | JSR   | INIT_SBY                |
|            | MOVE  | #SBY,CRNT_STATE         |
|            | JMP   | BK_TRK_EXIT             |
| NO_BK_BUMP | LDAA  | NEXT_D                  |
|            | BEQ   | REG_PATHING             |
|            | BNE   | IRREG_PATHING           |

  

|             |      |                    |
|-------------|------|--------------------|
| REG_PATHING | LDAA | SENS_C             |
|             | BEQ  | NO_RT_TRN          |
|             | PULA |                    |
|             | PULA |                    |
|             | STAA | NEXT_D             |
|             | JSR  | INIT_RT_TRN        |
|             | MOVE | #RT_TRN,CRNT_STATE |
|             | JMP  | BK_TRK_EXIT        |
| NO_RT_TRN   | LDAA | SENS_B             |
|             | BEQ  | RT_LINE_S          |
|             | LDAA | SENS_A             |
|             | BEQ  | LEFT_TURN          |
|             | PULA |                    |
|             | PULA |                    |
|             | STAA | NEXT_D             |
|             | BRA  | NO_LINE_S          |
| LEFT_TURN   | PULA |                    |
|             | PULA |                    |
|             | STAA | NEXT_D             |
|             | JSR  | INIT_LT_TRN        |
|             | MOVE | #LT_TRN,CRNT_STATE |
|             | JMP  | BK_TRK_EXIT        |

  

|               |      |                    |
|---------------|------|--------------------|
| IRREG_PATHING | LDAA | SENS_B             |
|               | BEQ  | NO_LT_TRN          |
|               | PULA |                    |
|               | STAA | NEXT_D             |
|               | JSR  | INIT_LT_TRN        |
|               | MOVE | #LT_TRN,CRNT_STATE |
|               | JMP  | BK_TRK_EXIT        |
| NO_LT_TRN     | LDAA | SENS_C             |
|               | BEQ  | RT_LINE_S          |
|               | LDAA | SENS_A             |
|               | BEQ  | RIGHT_TURN         |
|               | PULA |                    |
|               | PULA |                    |
|               | STAA | NEXT_D             |
|               | BRA  | NO_LINE_S          |
| RIGHT_TURN    | PULA |                    |
|               | PULA |                    |
|               | STAA | NEXT_D             |
|               | JSR  | INIT_RT_TRN        |
|               | MOVE | #RT_TRN,CRNT_STATE |
|               | JMP  | BK_TRK_EXIT        |

Have a subroutine which follows the lines, which depends on the sensor. These functions simply cause the eebot to turn based on a set of conditions which is called in the main code. One of the subroutines checks the state of the led and updates the Dispatcher.

The rest code consists of utility subroutine functions which have been covered in the previous labs and in the Guider code.

### **Problems Encountered**

Some of the main problems we encountered when working on the project is listed down below:

- Robot kept moving to the left
- One of the LED lights did not update/blink while the other ones did as expected
- Sometimes the LED stopped flashing after a while of running the bot

These are the main problems we encountered during our work on the project. We tried many different solutions to all these problems but none of them seemed to work. One of the possible scenarios was that we received a faulty bot where one of the sensors did not update or work as expected. Another problem could have been within the code portion of the project. Since the bot kept moving left and couldn't get a sense of following the black line, one possible explanation is that we coded the bot and it got stuck in a state of rotation. Evidently, with the bot not being able to switch states based off of the sensors, it stayed in rotation and couldn't respond to any stimulation.

### **Key Takeaways**

Some key takeaways from this project we had is to have better time management of the software development and testing part of the project. Preparing different code blocks for our project ahead of time can allow us to test them altogether and figure out which ones are the most suitable for us. On top of that, we should have tested the code out more frequently instead of cramming it all in the last couple of days before our demo time. Another key takeaway is to be open to re-coding functions of previous labs. We had a mindset of keeping all the functions and code of the previous labs because they were running properly. As a result, we did not want to alter any lab 5 code until we kept troubleshooting the project and had no option but to change a few parts of that code. In hindsight, we should have been more open to looking at all possibilities of code alteration during the development and testing phase. This project was a great experience for the both of us, we learned a lot in terms of what it takes to properly manage and develop a software project. In the future, we would definitely start our work a few weeks prior to the due date and consistently test and debug our software while documenting both the bad and good parts of the code.