Pivoting US Build Options

Rather than build a whole new bot, I will see if I can add a pivoting US Sensor. Therefore, I need to keep the current build in mind:

<table>
<thead>
<tr>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swivel</td>
</tr>
</tbody>
</table>

From "Beginning LEGO MINDSTORMS EV3", Mark Rollins

https://www.nxtprograms.com/explorer/steps.html
https://www.youtube.com/watch?v=Ro7T3q14uDY&feature=youtu.be
https://github.com/aramperez/EV3-Maze-Solver

https://www.smallrobots.it/ev3-tracked-explorer-mark-ii-preview/

https://www.youtube.com/watch?v=iO2HcqFCFPs

https://www.youtube.com/watch?v=SadmeTpGoPQ

https://www.instructables.com/id/Hawking-Bot/
https://github.com/EyeTreasure/HawkingBot
https://www.youtube.com/watch?v=nnCas87dHp8&feature=youtu.be

Hawking Bot Asse...

Maze runner

Traversing the Maze, Plan B - Pivoting Ultrasonic Page 2
Traversing the Maze, Plan B - Pivoting Ultrasonic Page 3
I like this one, but can't find build instructions.

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Coding the Pivot

Ultrasonic Sensor
The sensor can detect objects from approximately 5 to 255 centimeters away.
When the nearest object is beyond the maximum range of the Ultrasonic Sensor, the sensor outputs the maximum value, 255.

reset
Reset the motor’s speed setting and its counters.

    reset large motor A

    reset();
The motor’s speed is set back to 0 and the tacho, angle, and speed counters are set to 0.

From <https://makecode.mindstorms.com/reference/motors/motor/reset>

We will need to use this to reset the medium motor to 0 degrees, so we can then spin left -90, right 180 and back to the middle -90 degrees.

Gear Ratios
I have tried using degrees to move the pivot, but after many iterations, I have decided to work with gear ratios and pivot with rotations instead. The gear ratio can be calculated at: <http://gears.sariel.pl/>
So, I want my sensor to pivot a quarter turn, so I divide both sides of the ratio by 4

1.667:1 divided by 4 = 0.41675: 0.25

Left = -0.42 rotations
Back to middle = 0.42 rotations
Right = 0.42 rotations
Back to middle = 0.42 rotations

Algorithm/Code

```plaintext
on start
    reset medium motor ▼ A ▼
    run medium motor ▼ A ▼ at 25 % for -0.42 rotations ▼
    stop all motors
    pause 2000 ▼ ms
    run medium motor ▼ A ▼ at 25 % for 0.42 rotations ▼
    stop all motors
    pause 2000 ▼ ms
    run medium motor ▼ A ▼ at 25 % for 0.42 rotations ▼
    stop all motors
    pause 2000 ▼ ms
    run medium motor ▼ A ▼ at 25 % for -0.42 rotations ▼
    stop all motors
```
This worked perfectly! Much better than using rotation degrees.

Driving Forward until hitting a wall

My robot still has the touch sensor and I could just keep using it. However, I'm going to rely on the US sensor for the whole routine. So the robot just needs to drive forward until it reaches a wall. For some reason, I just couldn't get a while routine to work, so I used a pause instead.

Algorithm/Code

This works ok, but I'm sure there is a better solution

This video shows quite clearly the routine we are trying to achieve: [https://www.youtube.com/watch?v=Ro7T3q14uDY&feature=youtu.be](https://www.youtube.com/watch?v=Ro7T3q14uDY&feature=youtu.be)

Algorithm

<table>
<thead>
<tr>
<th>Loop forever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive forward until within 7cm of wall in front</td>
</tr>
<tr>
<td>If sensor &lt; 8 then</td>
</tr>
<tr>
<td>Look left and measure distance (leftDist = ultrasonic distance)</td>
</tr>
<tr>
<td>Look right and measure distance (rightDist = ultrasonic distance)</td>
</tr>
<tr>
<td>Move sensor back to middle</td>
</tr>
<tr>
<td>Compare</td>
</tr>
<tr>
<td>Turn 90 degrees with gyro in the direction that is greatest</td>
</tr>
</tbody>
</table>

Refinement

<table>
<thead>
<tr>
<th>Loop forever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steer motors turn ratio 0 speed 25</td>
</tr>
<tr>
<td>Pause until less than 7cm from wall in front</td>
</tr>
<tr>
<td>If sensor &lt; 8 then</td>
</tr>
<tr>
<td>Reset medium motor</td>
</tr>
<tr>
<td>Run medium motor 25 for -0.42 rotations</td>
</tr>
<tr>
<td>Stop all motors</td>
</tr>
<tr>
<td>playSoundEffect mechanicalSonar</td>
</tr>
<tr>
<td>leftDist = ultrasonic distance</td>
</tr>
<tr>
<td>Pause 1000ms</td>
</tr>
<tr>
<td>Run medium motor 25 for 0.42 rotations</td>
</tr>
<tr>
<td>Stop all motors</td>
</tr>
<tr>
<td>playSoundEffect mechanicalSonar</td>
</tr>
<tr>
<td>Pause 1000ms</td>
</tr>
</tbody>
</table>
Run medium motor 25 for 0.42 rotations
Stop all motors
playSoundEffect mechanicalSonar
rightDist = ultrasonic distance
Pause 1000ms
Run medium motor 25 for -0.42 rotations
playSoundEffect mechanicalSonar
Stop all motors

If leftDist > rightDist
  Calibrate gyro
  Steer motors -200 speed 25
  Pause until -90
Else
  Calibrate gyro
  Steer motors 200 speed 25
  Pause until 90

---

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This went mostly OK in the maze below. However, it missed the opening to the right. The other thing that happened was that the pivot gradually became mis-aligned.

The solution should probably be to just move in 30cm blocks and then look left and right etc.

I might swap to this pivot to see if it solves the pivot problem.
While I'm at it, I might use tank tracks.

IDEATION

Swivel

From "Beginning LEGO MINDSTORMS EV3", Mark Rollins


ev3-model-expansion...

simple_tracked_vehicle...

Versatile Builds

with Touch Sensor Bumper (page 25)

https://robotics.benedettelli.com/lego-wall-e/
Traversing the Maze, Plan B - Pivoting Ultrasonic

LEGOTank

basic-explorer-pathfinder

ExplorerRobotBuilder

ExplorerRobotOperator

ExplorerRobot

TankBotUltrasonic

Tanque3MoTores


Loop forever
if distance > 40
  tank 40 40
else
  stop all motors
  pivot US right
  rightDist = sensor reading
  pivot left
  leftDist = sensor reading
  pivot back to middle
  if rightDist > leftDist
    spin right until 30 degrees gyro
  else
    Spin left until 30 degrees gyro
  stop all motors
A little test to see if the US pivot does perfect 90 degree turns, left and right.

**On Start**
- Slow motors 8-14
- Turn ratio 8:30 speed 25% for 1 rotations
- Reset gyro 4
- Tank motors 8-14 45% 10%
- Pause until gyro 4 rotated -90° degrees
- Stop all motors
- Reset gyro 4
- Tank motors 8-14 45% 10%
- Pause until gyro 4 rotated 90° degrees
- Stop all motors

**Quarter turn of sensor platform**

1.4:1 divided by 4 = 0.35:0.25

I.e a quarter turn is 0.35 rotations.

**Forever**
- If there is a wall < 5cm away
  - Pivot right
- Drive a block forward
- Take measurements
- If Right is longest,
  - Pivot right

Traversing the Maze, Plan B - Pivoting Ultrasonic Page 13
Desk Check

The robot should now drive with this pattern.

2nd Refinement

Forever

If there is a wall < 5cm away
Calibrate gyro
Tank move 25 -25
Pause until 90

Tank move 25 25 1.5 rotations

Reset medium motor
Run medium motor 25 for -0.35 rotations
Stop all motors
playSoundEffect mechanicalSonar
leftDist = ultrasonic distance
Pause 1000ms
Run medium motor 25 for 0.35 rotations
Stop all motors
playSoundEffect mechanicalSonar
Pause 1000ms
Run medium motor 25 for 0.35 rotations
Stop all motors
playSoundEffect mechanicalSonar
rightDist = ultrasonic distance
Pause 1000ms
Run medium motor 25 for -0.35 rotations
playSoundEffect mechanicalSonar
Stop all motors

If rightDist > leftDist
Calibrate gyro
Tank move 25 -25
Pause until 90

Test this first, to see if it does 90 degree spins

2nd - now spin and drive

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3rd
just test out the pivot to make sure it works as expected. My pivot is on the left side, so I have taken away distances so that there is an equal comparison, left and right.

4th
How did it go? Did it act according to the deskcheck?

My bot couldn't re-centre the US sensor and all my reading were off. For my next iteration, I might use the one on the tankbot:

This one has a gyro on the pivot so that its rotation can be controlled. I'm not sure where the main fault lies. Perhaps taking out the gearing will help and maybe this solution is the best, as there is no gearing and the pivot is attached directly to the medium motor.
Ideation
I will build the explorer robot and add a gyro idea from the tank bot later if I have to.


Explorer Robot Bui...

Explorer Robot Op...

Explorer Robot

TripleTankBuild1

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For this iteration, I'm going back to basics:

<table>
<thead>
<tr>
<th>Left wall following routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>if there is no wall at left</td>
</tr>
<tr>
<td>turn left</td>
</tr>
<tr>
<td>else</td>
</tr>
<tr>
<td>if there is no wall at</td>
</tr>
<tr>
<td>straight</td>
</tr>
<tr>
<td>keep straight</td>
</tr>
<tr>
<td>else</td>
</tr>
<tr>
<td>if there is no wall at</td>
</tr>
<tr>
<td>right</td>
</tr>
<tr>
<td>turn right</td>
</tr>
<tr>
<td>else</td>
</tr>
<tr>
<td>turn around</td>
</tr>
</tbody>
</table>

Loop Forever
Pivot US and get readings

2nd Refinement
If there is no wall to the left
  Turn left
Else if there is no wall straight
  Drive straight
Else if there is no wall to the right
  Turn right
Else
  Turn 180

Loop Forever
  Pivot US and get readings
  If distLeft > 10
    Tank -25 -25 1.3 seconds
  Else if distFront > 10
    Tank -25 -25 500ms
  Else if distRight > 10
    Tank -25 -25 1.3 seconds
  Else
    Tank -25 -25 2.3 seconds

Test 1
Open left

Test 2
Open front
Advance 1 tile

Test 3
Open right
Test 4
Else in a dead end
All the tests worked out ok, however, the bot needs to turn in the right direction and move forward 1 tile as well, for each direction. This will solve the problem of turning left into an opening that it has just left. Eg

For this, I will build a move forward function that also detects if the bot is too close to the wall in front.

This will work by moving forward and stopping if it has moved 30cm (1 tile length) or if it is close to a wall in front. To get it to work, I am able to keep track of the angle of rotation of one of the drive motors. In this case it is negative because my brick is back to front.
I'm not sure if I have made this clear yet, but the stop all motors block is essential if you are using a pause until.

**fwdOneTile**
- Reset large motor
- Move forward until motor rotated 600 degrees OR close to wall in front
- Stop

This works fine by itself as:
Now I can add to the rest of the code; so I will turn and move forward each time.

```python
def follow_path
    reset large motor A
    tank motors A & B
    pause until large motor A angle
    stop all motors

    forever
        pause 1000 ms
        set distance to ultrasonic 1 distance
        pause 1000 ms
        run medium motor B
            at 100 % for 360 degrees
        stop medium motor B
        pause 1000 ms
        set distance to ultrasonic 1 distance
        pause 1000 ms
        run medium motor B
            at 100 % for 360 degrees
        stop medium motor B
        pause 1000 ms
        set distance to ultrasonic 1 distance
        pause 1000 ms
        run medium motor B
            at 100 % for 360 degrees
        stop medium motor B
            if distance 1 > 0.5 then
                calibrate gyro 2
                tank motors A & B
                pause until gyro 3 rotated 90 degrees
                stop all motors
                call function follow_path
            else if distance 1 < 0.5 then
                calibrate gyro 3
                tank motors A & B
                pause until gyro 3 rotated 90 degrees
                stop all motors
                call function follow_path
            else
                calibrate gyro 3
                tank motors A & B
                pause until gyro 3 rotated 180 degrees
                stop all motors
                call function follow_path
```
This works ok, but the gyro turns more than 90 degrees. Perhaps I will change it to turn 86 degrees or something. I could also look at lowering the US pivot and putting 'roll bars' around the bot. Definitely room for improvement.