Personal Development Plan- Final

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LO1: Student plans and executes a project in their track at level 2 of the HBO-i framework regarding autonomy and complexity, in an agile way

In my own words:

I want to build a small robot toy, that can drive, detect walls and do small tricks. I will focus on two main areas: Design and implementation in software and hardware interfacing. The design of the autonomous behavior, mechanical layout, and the realization of the embedded control system form the basis of my two main activities in this project. Deliverables include 3D mechanical models, embedded C code, circuit diagrams, and test logs validating sensor and motor interactions.

This is at level 2 of the HBO-I framework, because we will autonomously solve issues that arise from the project, and the context of the project is structured and unpredictable. There will be several basic concepts and a few in depth concepts.

Plan:

Week 1: Researched similar products to get a better idea about our product. Started to pick out components for our parts list.

Week 3: Initial Project Idea (DONE)

Week 4: Work Breakdown Structure, Project Development Plan, List of Components (DONE)

Week 7: Circuit Diagram, Project Charter, Project Pitch (DONE)

Project Week 1: Read datasheets for display, display controller, microphone, motors, servo.
Tried to use the microphone to record audio for voice commands, ran into issues due to missing amplifier in the microphone.
Created 3d files for body of the car, steering, motor holders.
Tested steering of the car.

Project Week 2: Improved 3d files for steering, added connectors for lego wheels. Created 3d files for gearboxes to increase motor torque. Improved gearbox to wheel connectors for more stable wheel rotation. Tried to make a small program to test drive the car. Ran into issues because of too low motor torque and too high of a current draw from the motors at start up. (Current Motors run at 3v, would be better to use 5v gear motors.)

Week 10: Finished mechanical design of the robot and added new gearboxes for higher torque. All files are 3d printed and assembled. Wrote a small test program to drive the car and test steering simultaneously. Did some research on what is necessary to make the car move autonomously. Decided to use kinematic bicycle model and pure pursuit controller. Started working on model and controller to make the car autonomously follow a path. Created software diagram for necessary parts of the software.

Week 11: Continued to work on controller and model, tested path following with clockwise, counter clockwise circle, and sine wave path. Did some adjustments to speed in the model and the default steering angle to get the car driving along the path. The car can now follow a pretty accurate path. Ran into issues with the power bank not providing enough power for the motors. Solved this by

adding 4 AA batteries under the car to power the motors separately. Rebuild a similar breadboard for my personal testing.

Week 12: Added mount for ultrasonic sensor as well as third microphone to determine direction of noise better. Added code for microphones and display. Added functionality for manual movement, this was necessary for the “listen and turn” functionality (vehicle should listen for noise and turn in the direction of the noise.) Fixed some issues with the movement handler to get this working.

Week 13: Issue with the ultrasonic sensor. When trying to determine the distance of an obstacle in front of the car the reading on the ultrasonic sensor gets distorted if the motors are running. This has the effect that the car thinks an object is closer than it actually is, a solution to this would be to make the motors run quieter by using grease in the gearboxes, or isolation the noise in another way. Another solution would be to use a different sensor than the ultrasonic, e.g. time of flight sensor. Updates were made to the circuit diagram. Designs for face animations were added.

Week 14: Changes were made to main code, including creation of states of the vehicle like IDLE, TURNING, MOVING_FORWARD, AVOIDING_OBSTACLE. When the vehicle is in idle state, it listens for a noise with the microphones and starts turning into the direction of the noise. If an object (presumably the object that made the noise, e.g. the person calling the pet vehicle) is detected below a certain distance then the vehicle stops turning and starts going towards the object.

Changes that need to be made: Add actual functionality to act like a pet. At the moment the vehicle can only listen and turn into the direction of a noise. The direction is determined by listening with the microphones and turning until an object is detected at a certain distance.
Add a better battery pack instead of the power bank and AA batteries.
Need to add logic to make use of automatic path following functionality.

LO2: The student demonstrates professional skills at level 2 in the focus areas: future-oriented organization, investigative ability, personal leadership, and targeted interaction.

In my own words: I want to further develop my professional skills by behaving respectful to stakeholders and delivering appropriate, relevant products that are meeting the requirements of the project.

Future-oriented organization is concerned with how teams work in flexible ways that adapt to changing situations. Investigative ability, this is about thinking critically and solving question that come up in the project. Personal leadership is about developing as a person in the context you operate in. Targeted Interaction is concerned with communication and collaboration, which play a key role when developing projects as a group.

Investigative Ability:

- Choosing parts for the project.
- Understanding how components work by reading datasheets.
- Understanding how gearboxes work with motors and how to choose them.
  (This was an issue because the car didn't run properly with the old gearboxes).
- Understanding how to draw circuit diagrams.
- Understanding how kinematic bicycle model and pure pursuit controller works.

Targeted Interaction:

- Clearly communicating design decisions and roles with teammates to avoid unnecessary work.
- Actively participating in group discussions to troubleshoot problems.
- Giving and receiving feedback respectfully during review meetings.

Personal Leadership:

- Asking for help when necessary, ensuring progress isn't stopped.
- Taking initiative to research solutions when the project encountered issues.

Future Oriented Organization:

- The team used agile stand-ups and sprint plans to adjust scope based on hardware issues. For example, after the motor power issue, we updated our power supply plan and changed design priorities accordingly.

Reflection:

In this project I focused on designing and realising an autonomous vehicle, working mainly in the hardware interfacing and software layers. I learned how to research components, solve integration issues, and implement control logic. For example, I adjusted my design after realizing the motors lacked torque, and improved the power setup after testing failures.

My investigative ability improved through working with datasheets, testing sensors, and debugging unexpected problems like ultrasonic noise interference. I also showed personal leadership by taking initiative when issues arose and keeping progress steady.

In terms of targeted interaction, I communicated design changes clearly in the team and collaborated well to solve technical blockers. One area I can still improve is future-oriented organization, some problems, like underpowered motors or sensor interference, could have been avoided with better early planning.

Overall, this project showed me the importance of adaptability and continuous learning in embedded systems development.