Date: December 15, 2019

Group 3 – UNIDEMA

Puppy machine – Design brief

Business name: UniDeMa

Team members:

- Le Doan Phuong Nhi (Scrum agile)
- Nguyen Phuong Thao (Effective communication)
- Phan Lan Khanh (Digital design & fabrication)
- Quach Thanh Thuy An (Mechanisms)
- Nguyen Phung Nhat Khoi (Electronics & power systems)

Client contact: Sebastian Dziallas; David Robert Bruce

Due date for completion: December 17th, 2019

Review date/s: The first prototype will be completed by December 9th, the second one will be by December 14th

Budget: 1.5 million VND

Product/service/brand name: UniPuppy

CONTENTS

PART I: OVERVIEW

Key objectives:

- This project is expected to be applicable at Fulbright, can accelerate the effectiveness of the community in working and studying. This product can be applied for the university/college community, both to strengthen the relationship among universities by having common concerns toward the product, to have financial benefits for the group and commercial values for Fulbright University Vietnam.
- This project is also determined to be a tremendous learning oppotunity for every members in our group. We would gain more knowledge about embedded system, mechanism and design process as well as cooperation skills.

Marketing objectives and target audience: This product is “puppy for pupils”. The main target audience is students in high school and university. The puppy is especially beneficial for students who are in stress, light depression, or simply anyone that needs to hear some encouragements, compliments, and to interact with. The product will be first spread among Fulbright via readout and posters, then to a wider market via articles on Fulbright website, Facebook page. In this project, product distribution is not as crucial as branding and commercial value for the university. By having a stress-releasing product by Fulbright student, it will shape the university branding as not just solely focus on academic performance, but student comprehensive development, which distinguishes Fulbright from other universities in the country. Hence, the product will be sent to some magazines’ editors for a wider range of awareness.

Regulatory issues:

- Following the policy of the area where the product is used (e.g., keep silent): we have to limit noise from the product; that means the response from the product should be loud enough just for the opposite people to hear.
- Google Assistant integrated with the product may be accidentally stuck in Copyright Law if we use the product as commercial value.

Scope: An automatic dog that can do some activities following:

- The dog can move around by wheels; when it meets obstacles (e.g., wall, table, chair), it can turn away and change the direction of motion.
- The dog can bark to cheer people up, bring joy to entertain everyone. This positive sound is a signifier for other people about the presence of the dog (to avoid hitting on it), and also a make-your-day element in the stressful college life.
- Initially, we planned to attach the wheel directly under the dog's foot. But the length of the 4 bamboo bars (making the legs) is not exactly the same - by many different factors (e.g, cutting bamboo irregularly, gluing the incorrect or unstable position) and bamboo bars are easy to crack when nailing on the wheel; therefore, it will be unbalanced for 4 wheels to approach the ground (e.g., perhaps there will be one wheel is skewed compared to the other wheels). So we have changed our strategy - buying an Acrylic Sheet and attaching the wheels into it instead of into the bamboo legs of the dog. After that, we will place the dog on Acrylic Sheet and fix it by nails. This also helps the product be more stable and more durable.

Not in scope:

- The dog cannot walk step by step with its feet. Its movement is based on the wheels under its feet. (Emulating the real movement of a dog would be super complicated).
- The product has no basic sense that means it is unable to understand.
- The dog cannot be the one that you can find to talk about everything – it cannot smartly respond.
- The dog does not respond to users. This is what we intended to build, but within the time constrain, we would prefer fulfill other basic features.
- The dog cannot give random compliments. This feature may be added in later versions.

Purpose and function:

- The body of the dog is made from bamboo.
- 4 wheels under 4 paws of the dog are attached with a motor that allow the dog to move and wander.
- The front sensor is to help it detect obstruction in order to change direction.
- Circuits: control
- Speaker: export the barking sound

Format:

- The product will be as large as a real Vietnamese dog (roughly 20cm x 40cm x 30cm)
- We will let the puppy run on Fulbright campus when it is not crowded, i.e. there will be only static obstacles

PART II: STRUCTURE

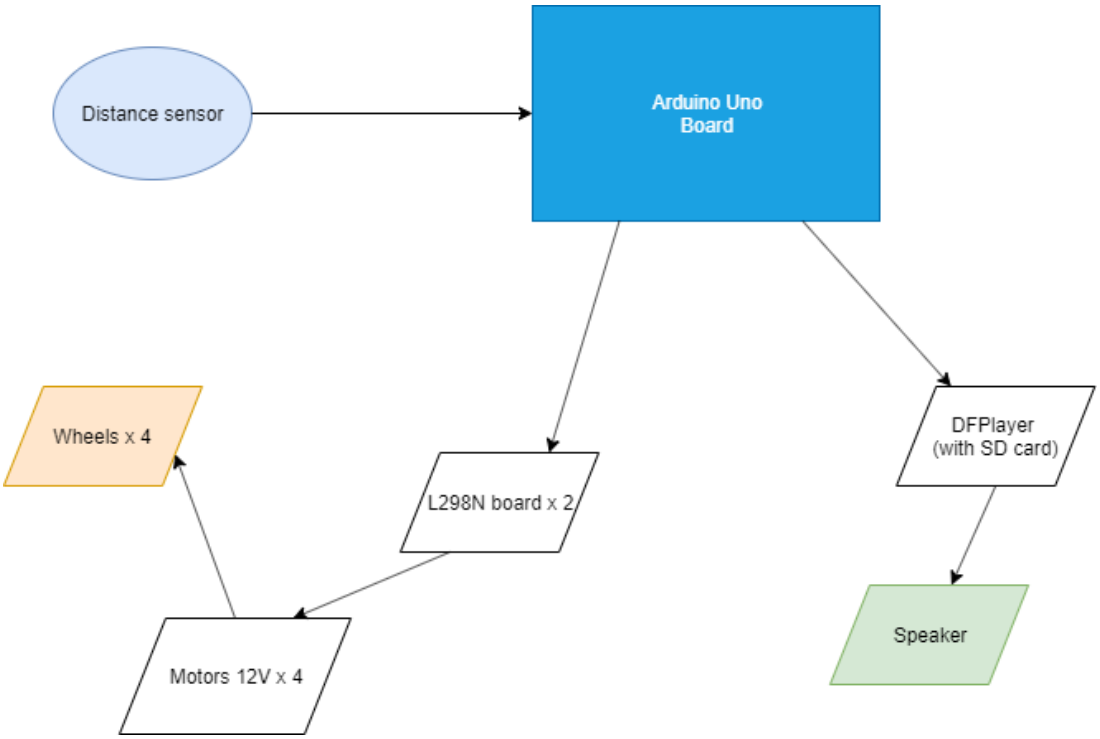
Arduino system

Overview:

Based on two main functions, wandering and barking, the dog contains 2 main parts:

- Moving system: The dog moves by wheels and recognizes obstacles by a distance sensor to turn around (by changing rotation direction of either left or right wheels)
- Barking system: This includes a SD card reader connecting to a speaker to play the barking sound or the compliments.

All these parts are controlled by an Arduino board (the dog's brain).

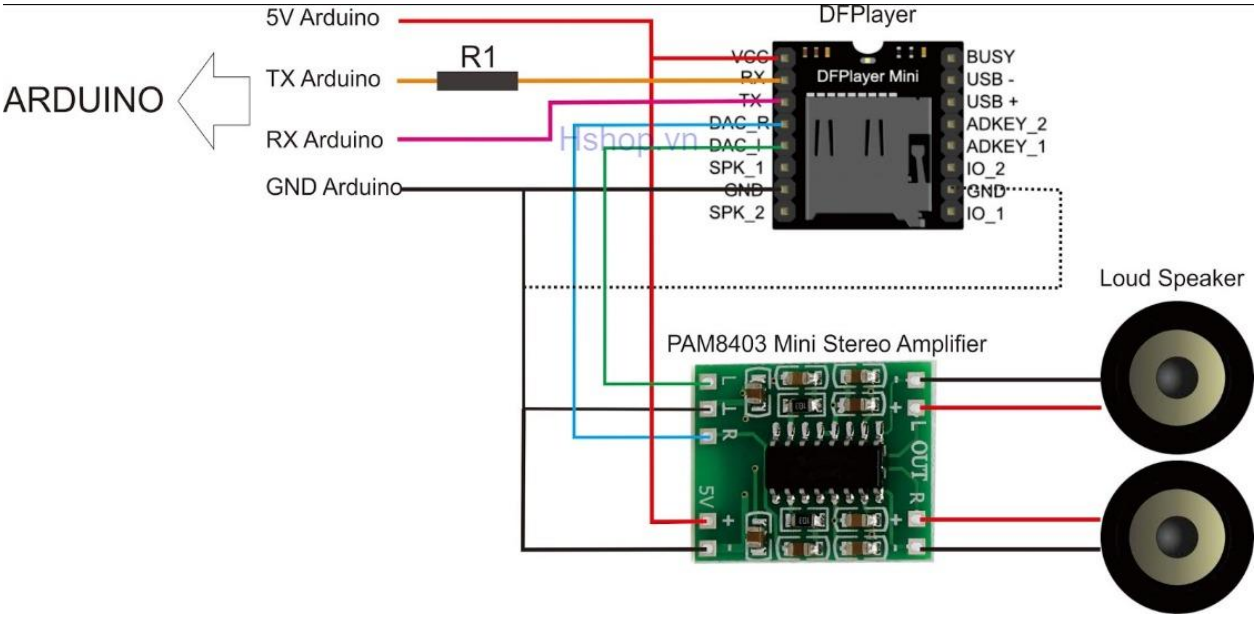


References:

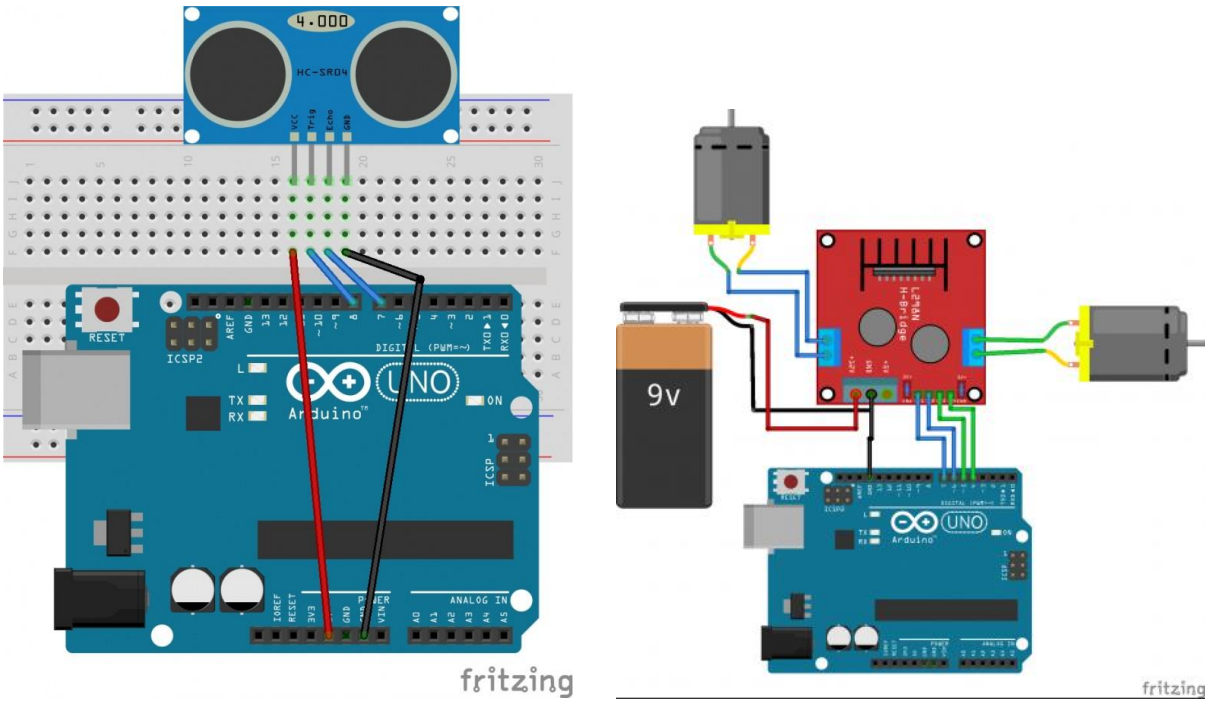
Almost all the implementation below is adapted from the following resources

- The motors: http://arduino.vn/bai-viet/893-cach-dung-module-dieu-khien-dong-co-l298n-cau-h-de-dieu-khien-dong-co-dc
- The sensor: http://arduino.vn/bai-viet/233-su-dung-cam-bien-khoang-cach-hc-sr04
- The audio player: https://hshop.vn/products/mach-phat-omthanh-mp3-ket-hop-amply-dfplayer-mini

Circuit diagrams:



DFPlayer circuit (cited from hshop.vn)



Distance sensor HC-SR04 (left); module L298N and motors (right) (cited from Arduino.vn)

Most of the joints presented on the images remain the same in our product, except for the order of *digital ports* on Arduino board. The reason is when combining all 3 parts above together, there would be some conflicts and disorganizations on Arduino board's digital row. Here is how we re-arrange them:

Attached devices			**Arduino ports**
Distance sensor		Trig	2
		Echo	3
1st L298N module (front wheels)	Front-right wheel (wheel 1)	IN1	4
		IN2	5
	Front-left wheel (wheel 2)	IN3	6
		IN4	7
		IN1	8

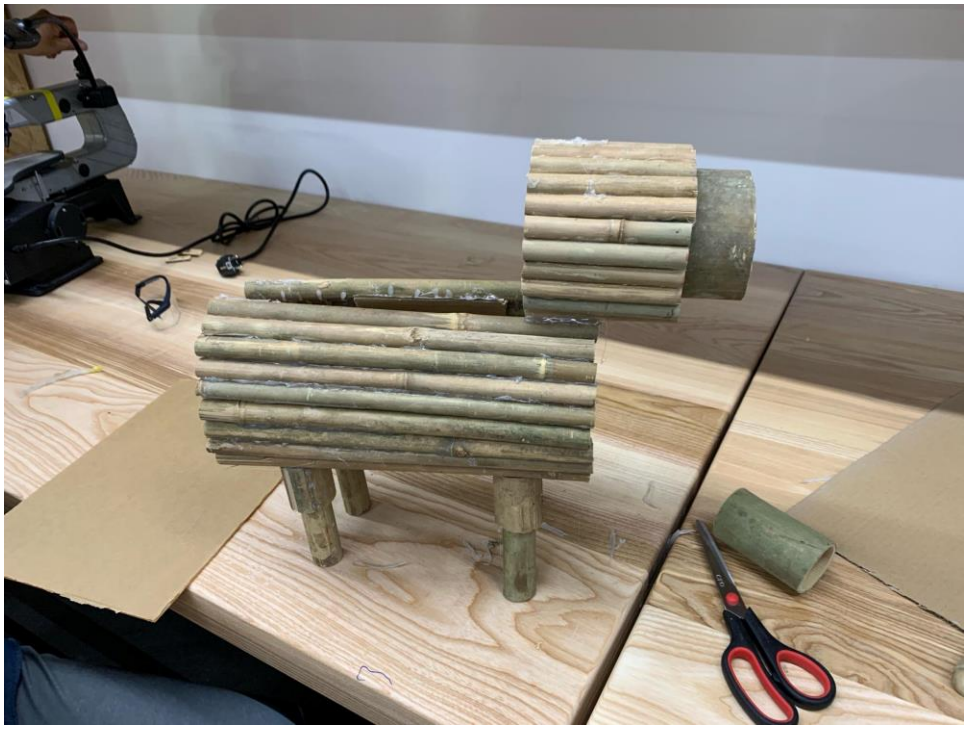
2nd L298N module (front wheels)	Back-left wheel (wheel 3)	IN2	9
	Back-right wheel (wheel 4)	IN3	10
		IN4	11
Audio player		RX	12
		TX	13

Source code: Please access this link: https://github.com/npnkhoi/UniPuppy

Code modification for developers (line 18-23):

- SPEED_1, SPEED_2, SPEED_3, SPEED_4: the current to 4 motors (min: 0, max: 255)
- N_DIST (default = 8 times): the number of most recent response about distance to calculated averaged distance. We have to get the average to reduce noises of the distance sensor.
- TURN_DIST (default = 50cm): the threshold for the machine to activate the turning around process.

Bamboo cover



Further features:

- A pair of ears
- A pair of eyes
- Filler for two ends to the body

Current features:

- The dog shape (this is not a bpg or the Troy's horse)
- A tray for developers to reach the circuit inside

PART III:
PROCESS & VALIDATION

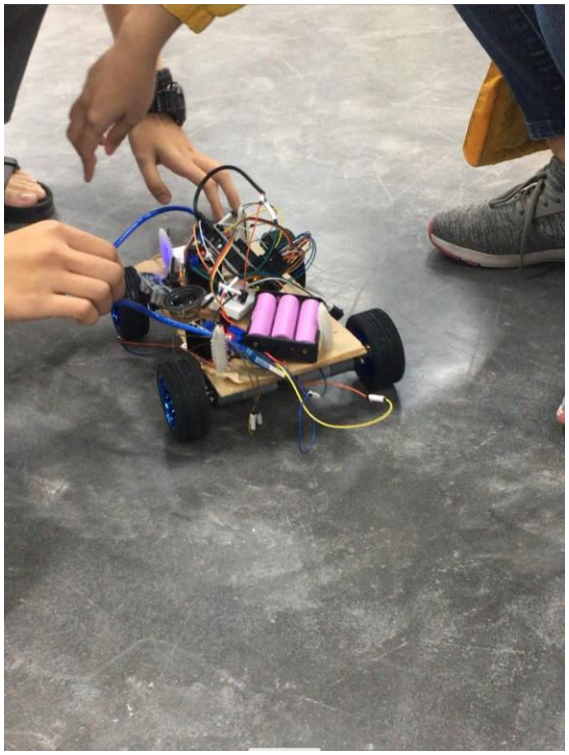
Design Project plan:

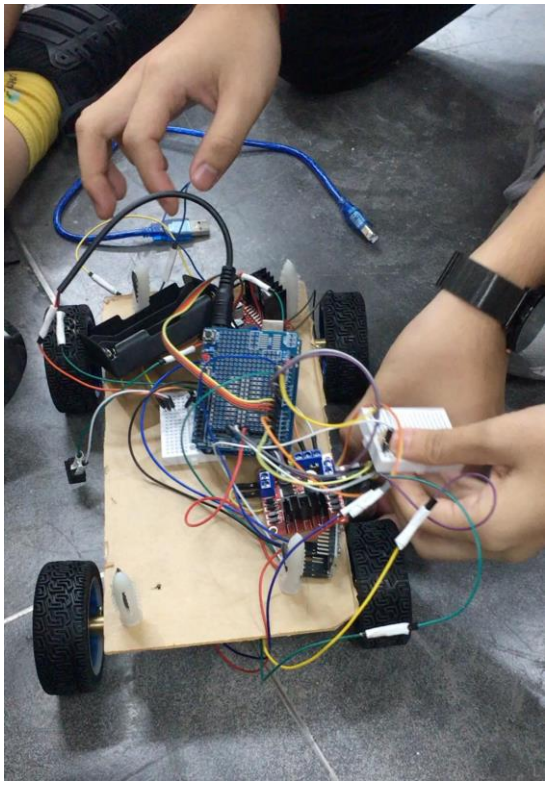
Milestones	Time	Detail	In charge
Finish design brief	Nov 17	First documented paper about the idea	Nhi, Khoi, Khanh
Budget plan	Nov 17	A plan of all the money we are going to use for the product	Thao, An
Research	Nov 20	Research how to use Arduino, Sensor, Motor to serve for the design	Everyone
Material Shopping	Nov 21	Go to Nhat Tao Market to buy the materials	Everyone
Preparing & Making	Nov 23 – Dec 1	• Prepare bamboo and finish the rough frame of the dog • Continue to research • Test & code Arduino	Everyone
Integrating parts together	Dec 3	• Finishing the Arduino system to attach to the bamboo shell.	Everyone

		• Put all of the circuits together	
Workshop	Dec 4 - Dec 14	Share information that one member (taking charge of that section) to other members. • Khoi's Arduino workshop • Khanh's Design workshop • An's Mechanism workshop • Nhi's Scrum Chart workshop • Thao's Logistics workshop	Everyone
First prototype	Dec 9	Including the main features: • Dog shape • It has a voice (barking, compliment) • Wandering	Everyone
Second prototype	Dec 14	Reviewing the old features. If it is completed, consider adding some AI with Raspberry Pi.	Everyone
Completion	Dec 13		Everyone

Visual Updates:

Engine prototype:





Final product:

Attachments:

- Processing part: Arduino Uno R3 module, distance sensor, speaker, motors, wheelers.
- Appearance part: bamboo, carton.
- Source code and tutorials about interacting with Arduino.
- Sample designs of dog made by bamboo.

Measures of success:

We will conduct at least 4 surveys with people on Fulbright campus, which are:

- After finishing the bamboo shell
- After finishing any of 2 features: wandering and complimenting
- After decorating

The surveys will be conducted by showing potential customers our prototype, ask them for (1) level of satisfaction and (2) improvements.

Question for the survey:

1. What animal do you think this model looks like?
    a. Horse
    b. Dog
    c. Duck
    d. Others
2. On the scale of 10, how many points do you give to this model? (Visual only)
3. Do you have any suggestion for the visual of this model?
4. Are you interesting in having a robot-dog running around our campus?
5. We are making a dog which can run around campus, automatically turn when meat the obstacle and communicate with people. What do you think about this idea?

6. Do you prefer the dog giving random compliments or having Google Assistant in its brain?
7. (If possible, record the sound of the dog) On the scale of 10, how many points do you give to the quality of this sound?