Prototype III and Customer Feedback

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INTRODUCTION:

In this deliverable, our main objectives are device a testing plan for out third prototype and discuss the feedback that we received on last client meeting. Furthermore, we will also demonstrate how this prototype inherits the results from previous two prototype and how our final solution continued by it (what we will do next). In addition, we will identify and explain both the stopping criteria and the results from analysis of system with risk and uncertainty included.

PROTOTYPING TEST PLAN:

1) Why are we doing this test:
   In last prototype (prototype II), we verify the functionalities of each type of sensor individually by checking the correctness of both Arduino codes and circuit connections. Thus, we will integrate all three types of sensors into one system. In other word, we will connect all sensors into one Arduino Uno board, and test the functionality of whole system. The main objectives for this prototype are the following: learning new ideas for final product, serving as approximation of final product to seek for improvements, testing for the risks and uncertainties, and test its feasibility and fidelity. Furthermore, our final product will continue on this prototype by adding several accessories such as protective case and power supplier.
2) Test Objectives Description:
   A. Specific test objectives:
      1) Learning new ideas about improvements of this prototype for final product.
      2) Verifying the feasibility of integrated Arduino coding, determining whether the sensor will be functional under same Arduino board and system.
      3) Verify the feasibility of circuit connections of Arduino board, breadboard, and sensors.
      4) Analyze the potential problems, uncertainty, and risk of integrated system.
   B. What being learned & communicated with the prototype:
      From the test results of last prototype, the code for each type of sensor is correct. Thus, we only need to put the codes into one IDE file and modify the data output ports according to the circuit connection of new integrated system. However, the circuit connection of this prototype is totally different with last one, so sufficient amount of research is required in order to guarantee the testing progress. Furthermore, we still need to work on the improvement of coding, especially the coding of LCD screen for temperature and humidity sensor which we currently stuck on it.
   C. Possible types of result:
      There are three possible results for this prototype testing. The largest possibility result is the coding of integrated sensors and circuit connections of integrated system is functional, but the coding for LCD may failure. Second possible result is our team reach our expectation that prototype III is 90% close to final product. Last result with

lowest possibility is our team fail our circuit connections for integrate system that we may need delay the schedule and restart prototype III.

D. How will results be used to make decisions:

The results will be analyzed and used to determine the risks and uncertainties. Then, we will come up revise plan base on the results to eliminate any risks and uncertainties as many as possible to approach our final product. Furthermore, the schedule and next step may modified depend on which possible results we will get.

E. Criteria for test success or failure:

The success or failure of the coding is mainly depending on the system checking of Arduino IDE software, as well as whether the sensors will be functional after we upload codes into Uno board. In addition, the functional sensors will also be the stop criteria for circuit connections. Furthermore, the serial monitor of Arduino IDE will also be another tool to test the functionalities of sensors and circuit, and determine the success or failure of the prototype.

3) What is going on and how is it being done:

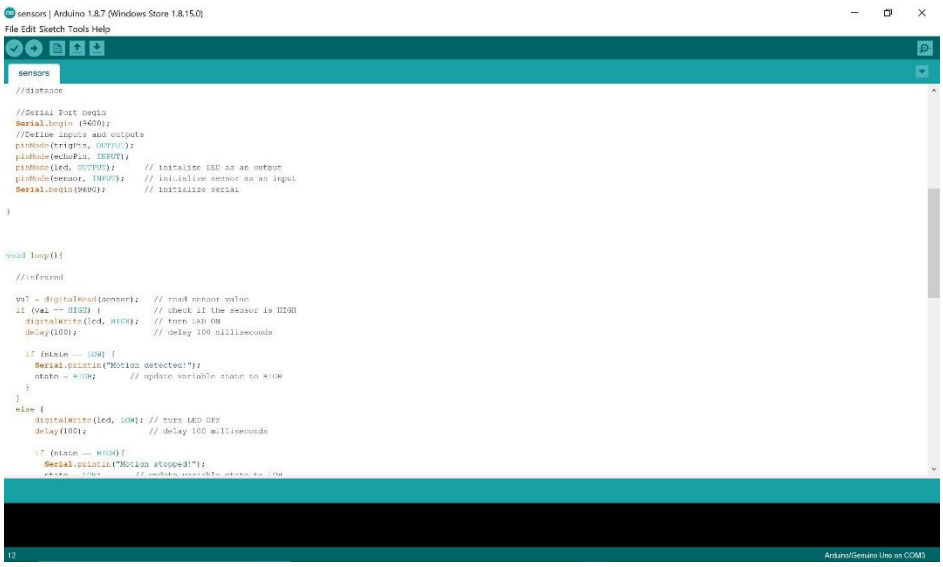
A. The reason for selection of this type of prototype:

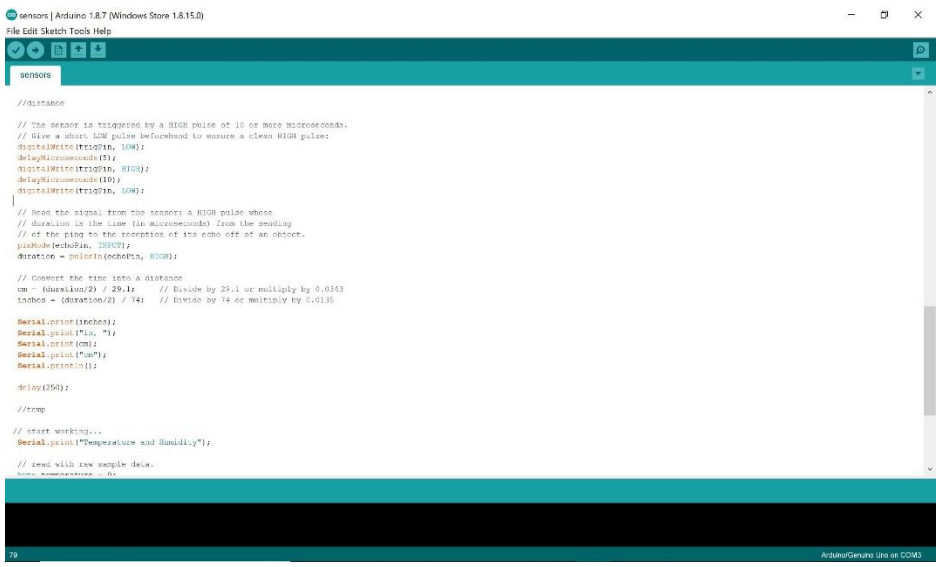
After discussion, our consensus is to use comprehensive prototype for this testing. The main reason for this decision is we are in the progress of integrated system which is the approximation of our final product, so we need to test all relative points in our conceptual design which grantee our final product is functional. Furthermore, we will analyses the risks and uncertainties base on the results of testing that determine any improvements we can add to this prototype to form our final product.

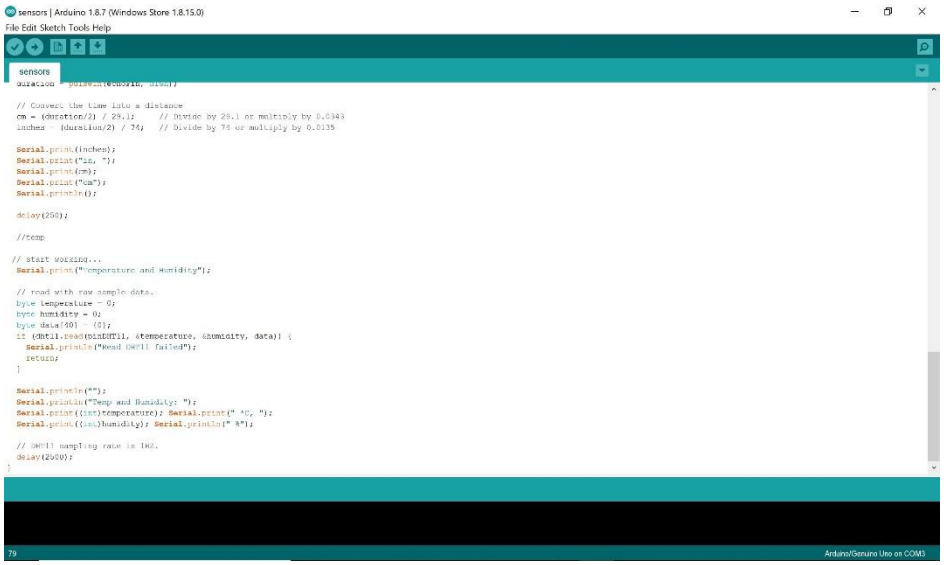
B. Testing process:

We firstly verify the integrated codes of sensors by Arduino IDE, and then we move to circuit connections between Uno board, breadboard, and sensors. Next, we upload the codes into Arduino Uno board after verification by the program, and open the serial monitor to check the correctness and functionalities of system.

1) Integrate system coding:




sensors | Arduino 1.8.7 (Windows Store 1.8.15.0)
File Edit Sketch Tools Help
sensors
//distance
// The sensor is triggered by a HIGH pulse of 10 or more microseconds.
// Give a short LOW pulse beforehand to ensure a clean HIGH pulse:
digitalWrite(trigPin, LOW);
delayMicroseconds(5);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
// Read the signal from the sensor: a HIGH pulse whose
// duration is the time (in microseconds) from the sending
// of the ping to the reception of its echo off of an object.
pinMode(echoPin, INPUT);
duration = pulseIn(echoPin, HIGH);
// Convert the time into a distance
cm = (duration/2) / 29.1;   // Divide by 29.1 or multiply by 0.0343
inches = (duration/2) / 74;   // Divide by 74 or multiply by 0.0135
Serial.print(inches);
Serial.print("in, ");
Serial.print(cm);
Serial.print("cm");
Serial.println();
delay(250);
//temp
// start working...
Serial.println("Temperature and Humidity");
79
Arduino/Genuino Uno on COM3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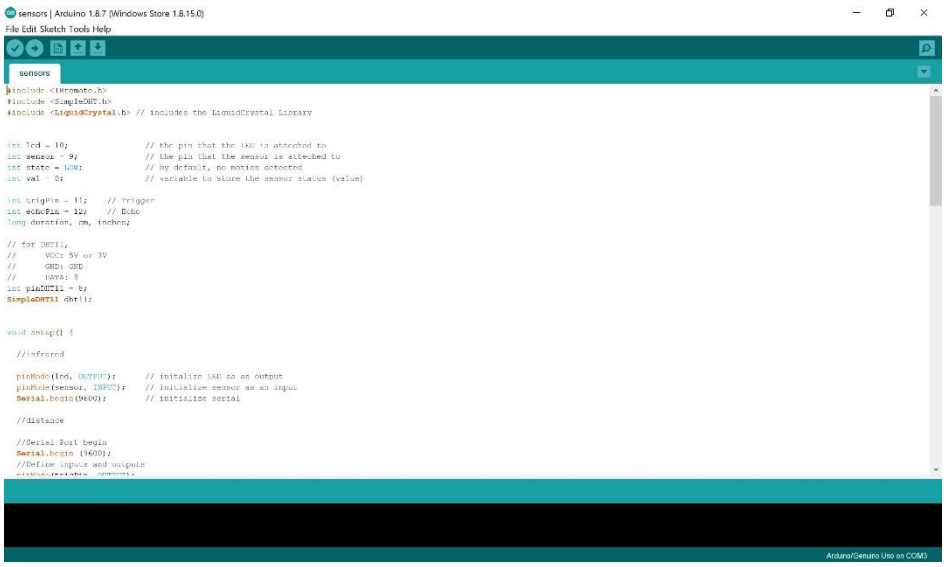
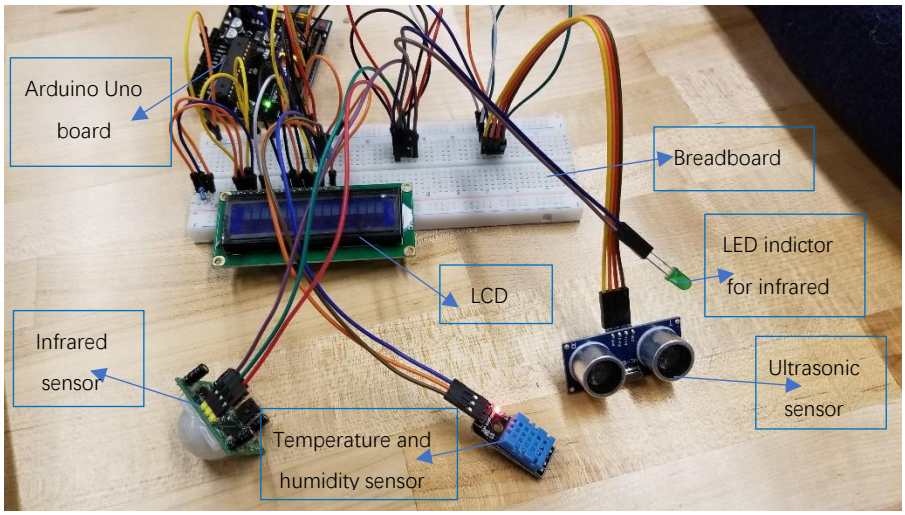
sensors
duration = pulseIn(echoPin, HIGH);
// Convert the time into a distance
cm = (duration/2) / 29.1;   // Divide by 29.1 or multiply by 0.0343
inches = (duration/2) / 74;   // Divide by 74 or multiply by 0.0135
Serial.print(inches);
Serial.print("in, ");
Serial.print(cm);
Serial.print("cm");
Serial.println();
delay(250);
//temp
// start working...
Serial.print("Temperature and Humidity");
// read with raw sample data.
byte temperature = 0;
byte humidity = 0;
byte data[40] = {0};
if (dht11.read(pinDHT11, &temperature, &humidity, data)) {
Serial.println("Read DHT11 failed");
return;
}
Serial.println("");
Serial.println("Temp and Humidity: ");
Serial.print((int)temperature); Serial.print(" °C, ");
Serial.print((int)humidity); Serial.println(" %");
// DHT11 sampling rate is 1HZ.
delay(2000);
}
79
Arduino/Genuino Uno on COM3


sensors | Arduino 1.8.7 (Windows Store 1.8.15.0)
File Edit Sketch Tools Help
sensors
#include <IRremote.h>
#include <SimpleDHT.h>
#include <LiquidCrystal.h> // includes the LiquidCrystal Library
int led = 10;   // the pin that the LED is attached to
int sensor = 9;   // the pin that the sensor is attached to
int state = LOW;   // by default, no motion detected
int val = 0;   // variable to store the sensor status (value)
int trigPin = 11;   // Trigger
int echoPin = 12;   // Echo
long duration, cm, inches;
// for DHT11,
//   VCC: 5V or 3V
//   GND: GND
//   DATA: 8
int pinDHT11 = 8;
SimpleDHT11 dht11;
void setup() {
//infrared
pinMode(led, OUTPUT);   // initalize LED as an output
pinMode(sensor, INPUT);   // initialize sensor as an input
Serial.begin(9600);   // initialize serial
//distance
//Serial Port begin
Serial.begin (9600);
//Define inputs and outputs
Arduino/Genuino Uno on COM3

2) Serial monitor:

3) Actual look during testing:



C. What information is being measured:

The correctness of the integrated codes for all sensors, of the circuit connections between Arduino board, breadboard, and sensors, of functionality of sensors.

D. What is being observed and how is it being recorded:

Both the codes and circuit connections for integrated system is correct, and the sensors are working as we expected according to the data showing on the serial monitor. The process of testing recorded by screenshots and picture as showing above.

E. Required materials and costs:

Same materials for the last prototype which we did not need to buy them again.

Material	Cost (CAD)
Detective sensors	$ 12.54
Temperature sensor & Infrared sensor	$ 39.99

Material	Cost (CAD)
Arduino board & other accessories	$ 38.99
Discounts	$ 9.25
Total	$82.27

F. What work needs to be done:

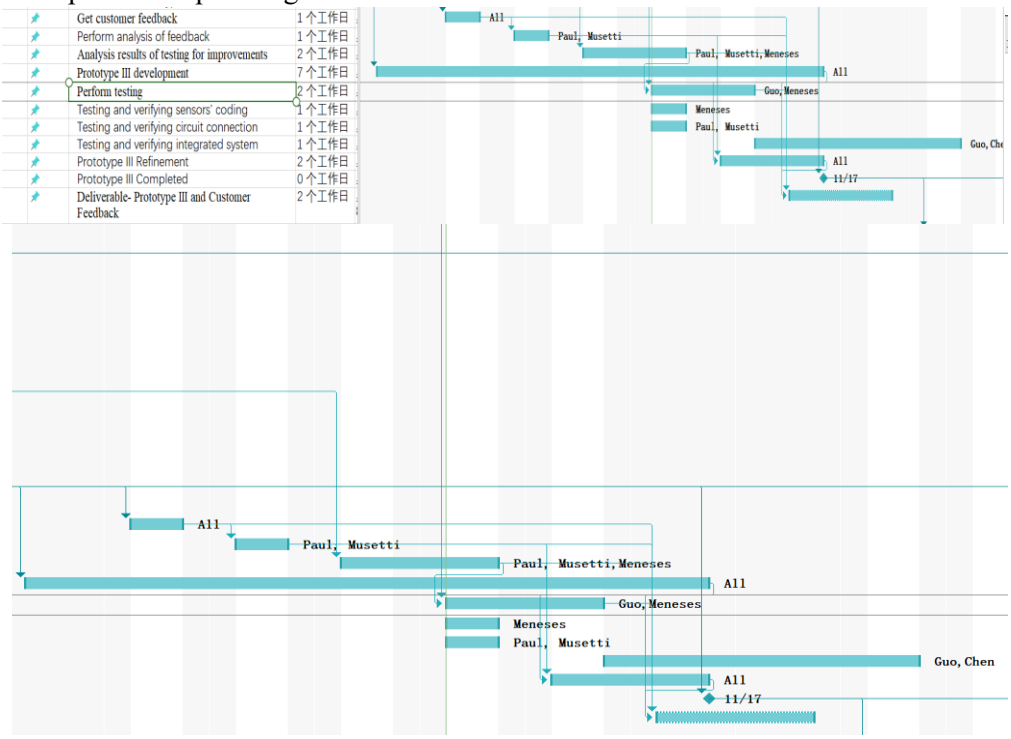
1) Finish the test of last prototype and perform appropriate analysis about improvements and uncertainties that can added or solved in this prototype.
2) Research for coding and circuit connections, such as IC bus, for integrated system.

4) When is it happening:

A. How long will the test take and what are the dependencies?

The total duration for prototype III is 11 days, which 7 days for development, 2 days for refinement, and 2 days for testing. All task involved in prototype III are depended on the completion of prototype II and third client meeting.

B. A separate test planning Gantt chart:



C. When are the results required:

The results from testing are required on November 17, 2018, because this deliverable is depending on the testing results and the due day is November 18.

ANALYSIS OF CRITICAL COMPONENTS OR SYSTEMS:

The coding of sensors and circuit connections for the integrated sensor system can present several risks or problems. One of these risks is that while making the robot it is common for shavings to get into the Arduino board. Anything left lying around in the same compartment as the Arduino can end up shorting something. It should be kept well covered in order to prevent this from happening. Another risk is one that can easily occur which is changing

connections while the Arduino is powered on. This should never be done because it makes it very easy to short something. Furthermore, overloading a pin can be a risk. The pins current limit should be known or else there is the danger of burning out the pin or the entire board. The total current being used by the integrated sensor system should be found as well as the current limit for the Arduino board. If the total current is more than the boards current limit, then there is the risk of frying the Arduino board.
To solve this problem an external power source may be required. Knowing how much power your integrated system needs compared to how much the Arduino board can provide is essential. Another risk is connecting more than 6 volts to any of the pins because it can overload it. Also, Arduino boards tend to heat up, affecting the temperature of the air surrounding it. This can affect the functionality of some of the sensors in the integrated system. Moreover, a risk is that the Arduino board should not be rested on conductive surface. It could cause it to short out. Another risk or problem is that wires can easily be mixed up. In order to prevent this from happening, a consistent wiring color code should be kept. For example, using red wires for power and black for ground. This keeps the integrated system well organized and easy to modify later. Additionally, another risk or problem would be connecting LEDs directly to addition pins without a current limiting resistor. Finally, a problem could be syntax errors in the code.
There are many mistakes to be made when coding and the most typical errors include: missing semicolons at the end of lines, missing/wrong type of brackets, spelling errors, etc. Any of these small errors can stop the code from working. Many of these risks or problems are similar or the same as those presented by prototype 2 in the last deliverable because both prototype 2 and 3 have the same critical components. The difference is that instead of being looked at individually, prototype 3 looks at the critical components together as an integrated system.

CUSTOMER FEEDBACKS:

After presenting our project goal and analysis of our prototype to Erin, we were given helpful feedback that we will implement into our prototype. Erin is interested in our use of sensors, but she was a bit confused with why we are using the sensors, and if it is for obstacle avoidance. We are indeed using the sensors for obstacle avoidance, since our priority is to create an efficient braking system for Bowie. Erin recommended the use of LED and LCD sensors into our prototype. The way we interpreted her message was that the LED sensors will be used as an indication that the sensor has detected something (an object). The LCD sensor will be used as a screen for the temperature sensor that we are using. These are things that will help improve the functionality of our prototype, and it is just a lot more convenient to include these aspects into our design. We will include these sensors into our third prototype.

LIFE-LONG LEARNING: TRANSFER OF KNOWLEDGE:

In this deliverable, we still apply the same knowledge as last two deliverables: the differences between different types of prototype and how to choose the most suitable prototype, how-to device a testing plan and execute it to test the fidelity of our prototype, how to receive and apply feedbacks, and how to come up modifications for our final solution based on the feedback. Furthermore, we choose comprehensive prototype is due to the reason that the purpose of this prototype is integration for the all sensors. In addition, we also learn some new skills such as IC bus for Arduino to connect multiple sensors, which will definitely useful for our furfure study/career.

CONCLUSION:

We develop a comprehensive prototype to test the correctness of both coding and circuit, and this prototype will be further developed into our final product. The results from testing are great that all sensors are functional under one Arduino. However, we still need to work on the coding part of LCD screen for temperature and humidity sensor, as well as the led indicator for ultrasonic sensor. The next step is discussing the improvements for the solution based on the feedback from last client meeting, and design a protection case for our system that we will get the fully functional product after achieving these.