**Project Charter**

**The charter provides a high level description of your project**

**Project Overview – Describe the project briefly in layperson’s terms (e.g., one that your grandmother could understand). This should not be more than a few sentences.**

1. The Brilliant Pad is a device that has the purpose of being an automated potty for dogs. Our project is to improve the Brilliant Pad device by adding a vision system through extra components such as a camera to increase its ability to detect a dog on the pad and to allow the pad to determine how soiled it is ie. 10%, 20% soiled. With this vision system, the Brilliant Pad will be able to automatically advance a soiled pad given a threshold of soiledness.

**Project Approach – Provide more technical detail (one that other students could understand). List the team members and their roles.**

Designer - Richard, Kevin, Derek

Programmer - Richard, Kevin

Hardware/Mechanical - Derek, Kevin

Documentor - Richard, Kevin, Derek

We are using a Raspberry Pi Zero and a Pi Zero Camera to detect waste on the BrilliantPad. Using a widely available computer vision library, OpenCV, we aim to use the image output of our Camera module to distinguish between a clean pad and a dirty pad.

**Project Objectives, Milestones and Major Deliverables – List your objectives and milestones without getting too detailed (you will do that later). What are the specific goals of the project for this quarter? What are potential longer term goals? Deliverables should include a description, a date, and the persons who are responsible.**

Create a concrete list of parts needed for this project and block diagram for overall system architecture - 1/28 (Derek)

Develop several mechanical schematics of where the Camera could be placed - 1/28 (Derek)

Create and design mechanical prototypes to mount the Camera on the Brilliant Pad

Create a 3D model in Solidworks for required mounts - 1/31 (Derek)

3D Print + mount the camera onto the Brilliant Pad - 2/7 (Derek)

Able to capture images/video footage from camera - 1/28 (Richard and Kevin)

Web presence (Derek)

Be able to extrapolate information from the image

Demonstrate interaction between OpenCV and Python - 1/31 (R + K)

Find contours/edges in the image - 2/7 (R + K)

Determine pad area from non-pad area - 2/14 (R + K)

Using the processed image to determine if there is a dog on the pad

Be able to detect a large object

Using the processed image to determine how soiled the pad is - 2/14

Get it to work with a baseline (50%) (R+K)

Using the processed image to determine if soiled threshold is met - 2/15 (R + K)

Demonstrate a test signal can be sent specifying how soiled the pad is.

Using the information of how soiled the pad is to create a signal that will be sent to the control module or control vision component of the other group (Derek)

**Constraints, Risk and Feasibility – What are the potential stumbling blocks? What is realistically feasible here? The quarter goes by very quickly. The better approach is to over-deliver on what you promise, rather than under deliver on a set of unrealistic goals. Be sure to include risks – a list of things that could go wrong and how to avoid them.**

The main stumbling blocks involve gaining enough knowledge of OpenCV to create a suitable vision system for the goal that we are trying to accomplish. Realistically, we will be able to gather data in the form of images and video from our Camera. We will have to start with small goals - for example, being able to detect simple shapes and contours.

We may be constrained by our choice of camera or microprocessor. For example, if the images generated by the Pi Zero camera do not have enough resolution, computer vision may not be that effective. Luckily, dog waste does not necessarily need to be detected in high resolution. We are also constrained by the current design of the Brilliant Pad, as the Camera must be mounted in a way such that it does not obstruct the dog and in a way that makes manufacturing simple for the company.

Risks include not be able to find the proper resources to complete this project. For example, it may not be possible to find enough image data to sufficiently train a machine learning algorithm to distinguish waste. However, with the wide amount of labeled images online this should not pose to be an issue.

* **Group Management**

**What are the major roles in your group’s management?**

Determining when to get together to work on the assignment and making sure we complete each milestone on time.

**How will decisions be made? By leader, consensus?**

We will have meetings and come to a consensus.

**How will you communicate? Email, meetings in the lab, discussion board?**

All of the team members live together, so we can easily communicate together in person, or through Facebook. Additionally, we will document all technical information and necessary files through Google Drive.

**How will you know when you’re off schedule, and how will you deal with schedule slips?**

It is easy to determine when we’re off schedule by comparing our progress to the milestones that we set for ourselves.

If we fall behind we will evaluate the situation to determine why we fell behind and work accordingly. We may re-evaluate priorities of functions and milestones and we may shift some of the roles around to help us get back on track.

* **Project Development**

**What are the development roles and who will handle them?**

**What hardware/software will you use? What do you have available? What do you need?**

For hardware, we are using a Raspberry Pi Zero and Pi Zero Camera. We also have access to the control module and PCBA of the Brilliant Pad.

For software, we are using opencv and python

For mechanical design, we will use Solidworks to create 3D models and print mounts for prototyping.

**If there is software/hardware that is needed, provide a justification for its cost. Where will you order it? When will it arrive?**

We have already ordered our Raspberry Pi and the associated camera, and they have both arrived. Alan Cook, the CEO of Brilliant Pet, has sent us a Brilliant Pad to work with.

**How will you do testing?**

Testing will be done in stages. Each milestone that we set should be able to be tested individually, and should be able to be tested with the equipment that we have on hand. Most testing can be handled fairly easily, though for the actual testing of the vision system for the Brilliant Pad we will likely begin with “simulated” waste before testing with actual waste.

**How will you do documentation?**

Documentation will be done on Google Drive. This will include all relevant documents, assignments for this class, and any research that we find. We will also document code files in Google Drive.

* **Project Schedule**

**Define a set of milestones with a specific definition of what each milestone is, what it means to complete each milestone, and when you expect to complete them. You must be able to demonstrate the completion of each milestone. For example, take a video of something work. Or make a graph showing how the data is processed. Define the milestones at two scales, a high level set of key milestones, and a low level set of weekly milestones.**

**Key Milestone 1 - Create and design mechanical prototypes to mount the Camera on the Brilliant Pad**

Definition: Mock-up of the mount

Deliverable: Pictures of the mount setup on the Brilliant Pad

Expected Date of Completion: 2/7

**Weekly Milestone 1 - Planning**

Definition: Defining system specifications, assembling list of parts, create block diagram/system architecture

Deliverable: List of system specifications, list of parts, block diagram

Expected Date of Completion: 1/28

**Weekly Milestone 2 - Designing**

Definition: Determine how and where the camera/sensor should be mounted on the Brilliant Pad, determine required dimensions

Deliverable: Drawing of expected placement, dimensions of mounts

Expected Date of Completion: 1/28

**Weekly Milestone 3 - CAD**

Definition: Create 3D CAD for Camera + Raspberry Pi mounts

Deliverable: Screenshot of 3D Models

Expected Date of Completion: 1/31

**Weekly Milestone 4 - Building**

Definition: 3D Print the model that was created, and mount the required devices onto the Brilliant Pad

Deliverable: Picture of the Pi Camera mounted onto the Brilliant Pad in various angles

Expected Date of Completion: 2/7

**Key Milestone 2 - Web Presence and Documentation**

Definition: Create a “web presence” and document all required information about our project. Goal is to also document information well for the Brilliant Pad company.

Deliverable: Accessible webpage

Expected Date of Completion: 2/7

**Weekly Milestone 1 - Ongoing Documentation of Process**

Definition: After every milestone is completed, there should be documentation stating what was done, by who, and when it was completed. Documentation is especially important so that Brilliant Pad engineers can make use of our design.

Deliverable: Information on accessible webpage

Expected Date of Completion: 3/17

**Key Milestone 3 - Gathering and Analyzing Information of the Pad**

Definition: Image processing

Deliverable: A video demonstration of the camera capturing a picture and processing it into relevant information needed for the pad.

Expected Date of Completion: 3/2

**Weekly Milestone 1 - Image Capture**

Definition: Capturing an image on the Raspberry Pi.

Deliverable: Show an image of the camera’s POV when mounted on the Brilliant Pad.

Expected Date of Completion: 1/28

**Weekly Milestone 2 - Isolate Pad Area from Non-Pad Area**

Definition: Identify and extract the relevant parts of the image.

Deliverable: Show a black and white image separating pad from no pad (waste).

Expected Date of Completion: 2/4

**Weekly Milestone 3 - Soil Level**

Definition: Determine what percent of the pad is covered by waste

Deliverable: A video demonstration showing the module is able to detect how soiled it is with simulated waste

Expected Date of Completion: 2/11

**Weekly Milestone 4 - Analyzing Pad**

Definition: Determine if the pad should be advanced based on the level of dirtiness of the pad

Deliverable: A notification that indicates the pad should be advanced (blink an LED)

Expected Date of Completion: 2/18

**Weekly Milestone 5 - Detecting Presence of the Dog**

Definition: Determine whether the pad should advance or not based on the presence of the dog

Deliverable: A notification that indicates the pad will advance (blink an LED)

Expected Date of Completion: 3/2

**Key Milestone 4 - Communicate with Brilliant Pad**

Definition: Using UART to tell the Brilliant Pad to advance the pad

Deliverable: A full working product that can detect the dog and how soiled the pad is, and advance the pad

Expected Date of Completion: 3/9

**Weekly Milestone 1 - Send a Signal to the Brilliant Pad**

Definition: Telling the Brilliant Pad to advance the pad

Deliverable: A video demonstration of the vision unit advancing the pad

Expected Date of Completion: 3/9