**Title Slide**

* The project I will be presenting is “Using AI and Robotics to Entertain Cats”.

**Project Description**

The project will take the form of an intelligent robotic toy designed using principles of robotics and AI. This will be a free moving product will aim to be cheap, but effective with good functionality and a durable structure. It will be based on “catch the mouse” style toys available on the market while expanding on what these are capable of as they are mostly static on the surface. The project will use image recognition to evade the cat interacting with the toy and avoid obstacles that are in the same space as it. The main hardware tool being used in the project is the Raspberry Pi Zero W computer board. All software necessary will be stored here and all other peripheral components with be connected to this. The Python programming language is being used for the software aspect of this project.

**Aims & Objectives**

The aims of this project are split up into 3 distinct categories. Major goals, which are essential for the completion of a working project. Minor goals, which are not essential but highly desirable for the completion of a high quality project, and a stretch goal that would take the project into more advanced technical areas.

The first major goal is to have the robot performing basic movement on its own across surfaces in all possible directions. Another is to implement basic AI object recognition. In its most basic form this would allow the robot to make informed movements as not to hit any obstacles, but it may not display very intelligent behaviour in terms of interacting with the cat. The final major goal is to house all components as compactly as possible within the robot. The hardware needs protection and the robot itself has to be a reasonable size and have some sort of package or shell holding it together in order for it to be durable and structurally sound.

The first minor goal is to implement more advanced object recognition algorithms to allow robot to adapt to its environment. We want the robot to be able to make high quality informed decisions on its next movements by recognising particular objects. The other minor goal is to create an aesthetically pleasing robot to the cat. Whether this is making it have the appearance of a mouse, being brightly coloured, or something else, we want the highest chance possible for the cat to be engaged with the robot, and completing this goal will ensure that happens.

The stretch goal of the project is to research and incorporate AI machine learning into the robot so that it can display more intelligent behaviour by learning patterns of movement from cats each time it interacts with them.

**Technical Overview**

Diagram explanation: The most essential component in the diagram is the Raspberry Pi. Almost everything else is connected to it in some way, the other major pieces of hardware are wired to it so they can receive their instructions from the code stored in the SD Card within the Pi. The wheels and motors are wired to the H-Bridge Motor Controller before this is wired to the GPIO pin rack on the Pi. This allows the 2 motors to be controlled independently from one another and have different signals sent to them if required. The GpioZero Python library is being utilised to allow signals instructing the motors and wheels on what to do next to be sent through specific GPIO pins to the motors via the H-Bridge controller. Between the wheels a ball castor will be placed to aid easy movement across more friction-causing surfaces. The PiCamera is connected via flat cable, and an adapter to allow for the dimensions of the Pi Zero Series, to the end of the device. The PiCamera Python library is being taken advantage of to capture visual input to be analysed to image recognition. This image recognition is aided by another library, called OpenCV real-time image detection. This has many pre-defined objects in its database that it can instantly classify given a stream of visual input. Some of these are particularly helpful in this application, including “cat” which will be the most essential. Other objects in the OpenCV database that are helpful include “chair”, “table”, “door”. What makes this so useful is that as well as classifying objects that it recognises, it gives them a “box” which is a square area roughly the size of the object with a small margin of error. This allows our robot to then move towards or away from , to follow or avoid a certain object by tracking its box.

**Current Progress**

The first step, after deciding with my supervisor what we wanted the technical detail and goals of the project to be, was to source all of the components required and have everything together ready to start working on the project. Once that was done, the next step was to configure the Raspberry Pi for Python 3, and to have all relevant modules installed onto it.

The next stage was then writing and performing tests for the 2 major peripherals, the camera and the motors. For the camera, a test function was written for both capturing still image, set length video, and looping stream video in order to make sure it has full function. The most attention was paid to the looping stream video as this is what will be used in the project to aid the movement of the robot. For the motors, functions were written and carried out for varying tests of movement for the motors and wheels, including the motor action required for straight line movement, moving in a square pattern, and moving in a continuous circle. The aim was to test the ability of the motors individually before the project moves on to a more advanced stage.

After this, a lot of work was done on utilising the Open CV library. Currently, the Python framework takes the current state of image being captured by the camera, and looks through the OpenCV database for recognisable objects in frame. Once an object is recognised, it is stored in a temporary database for the remainder of this video stream loop. The objects detected and their location is then passed to the movement algorithm, which will use this information to determine what the most logical next movement step for the robot should be, and sends appropriate signals to the motors for this.

Unfortunately the SD Card being used in the Raspberry Pi became corrupt, therefore the testing of code and construction of the project as a whole was slowed down. It also came at a time just before the exam diet was starting and also during Tier 4 restrictions in Glasgow City, meaning all non-essential shops were closed and the accessibility of gaining a new SD Card quickly was greatly reduced. However, I am still happy with the progress I have made up until now and do not see the delays I have experienced as a huge cause for concern as long as work is consistently done at a good pace in the second semester.

**Next Steps**

I have split up the next steps of the project into what most urgently need to be done for each of the 3 major goals of the project.

For implementing the movement of the robot, one of the very first things I intend on doing once university reopens, is gaining access to the lab so that the wires can be properly soldered onto the motors, and onto the pins, so that all components can begin to be tested together. Once this is done, the current movement tests carried out can be put into action, and further ones carried out to include the code already in place.

Implementing basic AI object recognition is the major goal that has had the most progress made on it thus far, but we will soon be able to see how effective the image recognition code works in tandem with the movement algorithm in actually informing good decisions for the robot. From this improvements and changes can be made to make it a better product moving forward.

In terms of housing all components as compactly as possible within the robot, this has not been done yet. A shell needs to be designed and created to house the components to have a full product. This is the major goal that has had the least progress so far out of the three.