Pick and Place Game with Mobile App using Robotic Arm

Detailed Project Plan

Chung Pui Yin 3035569160

Table of Contents

1. Background P.2-3
2. Objective P.3-4
3. Methodology P.4-6
   3.1 Mobile App P.4-5
   3.2 Robotic Arm P.5
   3.3 Games P.5-6
4. Schedule and Milestones P.6-7
5. References P.7-9
1. Background

There are different kinds of robotic arm and robotic tools to help making jobs easier nowadays. However, there is not much on the field of entertainment for humans. Currently, most of these robotic components are designed to help with humans’ work like packaging products in factories, performing certain step in the progress of making a product, etc. Also, there are some but not much on interacting and entertaining humans. For example, a robotic arm had been made to play table tennis with human which can detect the ping pong ball and hit back the ball like a normal player. However, these are just on the level of production and sports entertainment.

In this project, the product made which is the robotic arm controlled by the mobile app can act as a real player to play games with a human. In the current society in Hong Kong, most families comprise of parents and only one child due to the expensive daily expenditure and heavy stress. In addition to the fast technology progression, smartphones and tablets are very common and affordable for many families. Also, many people living in Hong Kong has long working hours and may not be willing to spend a lot of time to play with their child. Instead, they just give their child a smartphone or tablet for their entertainment. This is not responsible and bad for their growth which will cause different problems. The robotic arm made in this project can act as a real player to play games with the human player like chess or other games. Therefore, the this can help providing entertainment in a healthy way with the help of technology. Also, playing games with real objects is better than playing it on smart devices because the player can grab the object directly instead of
tabbing the screen which help training the child’s ability to use the hands and brain.

The reason why I want to complete this project is that I can use the knowledge that I learned from the courses taken including programming language and mobile app programming. Therefore, this is an adequate opportunity for me to practise what I had learned, and I think it will be an interesting task as a FYP.

2. Objective

In this project, the final product is a robotic arm and a mobile app for android phone. There are several functionalities that the robotic arm can perform which are movement, picking up an object and putting down an object. Besides, there also several functionalities the mobile app can perform which are capturing the game state, calculate the action to be performed by the robotic arm, sending signals to the robotic arm and acting as a control panel for the user to control the robotic arm manually.

The robotic arm can be controlled manually or automatically by the mobile app to move in 3 axes of directions in the 3D plane (X, Y, Z) which is forward, backward, left, right, upward and downward. For manual control, the user can access the mobile app to control the robotic arm by tabbing some virtual buttons in the app including moving, the robotic arm, grabbing and releasing
object. For automatic control, the phone must be placed at a place which can capture the game board and the game objects clearly in order to identify the game state. The app will send signal to the robotic arm to control its actions including moving to a position, grabbing an object and releasing an object. The 2 modes can be switched by tabbing the buttons in the app.

The mobile app contains several functionalities, including capturing the game state, calculating the best move, sending signal to the robotic arm and acting as a control panel in manual control mode. Therefore, the device must be installed with a working camera. The camera will keep capturing the game board and game objects so that the app program has access to the current game state. Then, the program will calculate the best move according to the rules of that game which is pre-coded in the program. Therefore, the games available for this mobile app and robotic arm is limited. After the calculation finishes, the corresponding controls will be sent to the robotic arm to perform movement and pick and place actions. For manual control mode, the app will display a control panel which contains virtual buttons for the user to control the robotic arm directly.

3. Methodology

There are 2 main parts of this project which are the programming part of the mobile app(software) and the assembling of the robotic arm(hardware).

3.1 Mobile app

For the programming part, the mobile app will be coded using Android Studio in Java language. Since the app is designed for mobile phone, the user interface must be designed in a user-friendly manner. The app functionalities
include a manual control mode to control the robotic arm manually, automatic mode to capture the game state and control the robotic arm remotely. The manual control will be implemented with simple button interactions by Java coding to send signals to the robotic arm while the capturing of the game state will be implemented using OpenCV which is a tool to help detecting and identifying various objects.

3.2 Robotic Arm

For the robotic arm part, firstly the 3D model must be designed using computer. Some applications may be used in the 3D modelling part, which are Solidworks or Blender. These are software for 3D modelling where the former is paid but provides more functions specified for 3D modelling for engineering while the latter is free and provides sufficient functions for 3D modelling. Next, the 3D printed parts must be assembled with the motors and other mechanic parts for the movement. In order to take input or signal from the mobile app, an electronic part is required which is the Arduino board. It can receive inputs and give outputs to control real life objects like turning on the motor, etc.

3.3 Games

Another important element of this project is game. As stated in the project title, the mobile app controls the robotic arm to play a game with the player.
There are many different games that are suitable for this project. For example, chess, Chinese chess, Chinese happy chess, Connect Four, etc. Some are more difficult to play due to the complicate rules while some are easier with simple available moves. Therefore, the easier game like Chinese happy chess will be implemented first. If there is enough time, the more complicated games will be implemented. Also, different games requires different implementations since the rules and the object to be detected are different.

4. Schedule and Milestones

The web page will keep updating weekly.

By 3rd, October 2021, the detailed project plan will be finished, and the web page is expected to be set up.

By 23rd, January 2022, the interim report will be finished, and the robotic arm should be working fine. The mobile app should provide basic functions like
movement of robotic arm but the game object capturing may not be completed yet in this stage.

By 18th, April 2022, all the deliverables including the mobile app and the robotic arm will be finished and should work fine without errors.

References


Image 2:

Image 3:

Image 4: