

Hong Kong Baptist University

Final Year Project First Progress Report

Moving Object Tracking – Project Cortex

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Background

In this project, I will focus on enhancing the experience of the Mind Drive competition, held by Hong Kong Baptist University, Department of Computer Science.

The Mind Drive competition is one of the proud workshops of the department, allowing freshmen of Department of Science and secondary school student to participate and compete with others. They are asked to design, implement, and test a program which control a remote car using posture in front of a Kinect camera and race with other teams.

This competition has been a great success, attracting many teams from different secondary schools compete in the 60th Anniversary of HKBU Mind Drive celebratory event.

I named this project as “Project Cortex”, as cortex being a region of a human brain, which plays a key role in a person’s memory, cognition, and vision processing. Not only this name matches the topic of motion tracking, it also echoes with target theme, a “Mind” driven game.

Objective

The main objective of this project is to develop a real-time automatic recording system for the Mind Drive Competition. The recordings are mainly used for game rules judgement call and for sharing purpose. The system should be able to:

- Recognize the position of the remote car relative to the camera capturing area in real time.
 - Re-track when lose vision of the remote cars.
- Automatically adjust its camera angle to track the remote car during game.
- Automatically adjust its camera zoom according to different game situation.

While achieving these objectives, the core game rules and styles should not be affected by the implementation of the system. For example, the design of the racing track, specification of the remote cars, and the environment where the games are played in should be the same or at least as close as before the system employment.

Current Solution

The current solution of game recording are student helpers of the competition record it using handheld devices with no gimbal or stabilizer. It is effective way to record the game in terms of the freedom of moving camera angle and possibility of using a heavy high-end camera.

However, it costs human resource to perform such recording, and it is a relatively boring duty. Also, the current solution involves human input to control: 1) what to be captured; 2) in what method is it captured. Since the recordings could be used for rules judgement, it will be better to have someone or something to perform the filming of evidence in a consistent way.

Proposed Solution

Project Cortex propose a new solution to solve the problems of current solution, to build an automated recording system includes the remote car tracking system and the camera gimbal system which is where the tracking system and recording devices and mounted on.

Tracking System

The tracking system would use infrared camera and infrared LEDs as main tracking mechanism. An infrared source (Infrared LEDs) will be attached on the remote cars which are required to be tracked. Then, we use infrared camera to find the infrared source. An infrared bandpass filter that matches the source infrared central wavelength can help the system to highlight the position of the remote car. It is done possible because only the infrared light within the target wavelength can pass through the filter and be sensed by the camera sensor.

Gimbal System

Using two (or four in pairs) servo motors to build a 2-axis camera mount, we can create our own gimbal system that can be used to rotate the tracking system accordingly. For example, if the remote car is at the top side of capturing screen, the gimbal should rotate its tilting axis upward so that the camera will look up, in order to compensate the displacement of the remote car relative to the tracking system.

Proposed Schedule & Progress

Double Week	1	2	3	4	5	6	7	8	9	10
Date	1-Aug	15-Aug	29-Aug	12-Sep	26-Sep	10-Oct	24-Oct	7-Nov	21-Nov	5-Dec
	Research on Topic									
		Prototyping and Testing								
		Order Parts								
					First Report					
						Implementation - Tracking System				
								Gimbal System		

Double Week	11	12	13	14	15	16	17	18	19	20	21
Date	19-Dec	2-Jan	16-Jan	30-Jan	13-Feb	27-Feb	13-Mar	27-Mar	10-Apr	24-Apr	8-May
	Implementation - Tracking System										
	Implementation - Gimbal System										
	Midpoint Report										
	Implementation - Whole System										
					Final Adjustment						
						Abstract					
							Final Report and Presentation				

Currently, I am working on “Prototyping and Testing”, “Order Parts”, “First Report”.

Prototyping is important for me to test the parts I have bought and adjust the design of final solution. I have ordered an 850nm infrared wavelength bandpass filter camera and some 850nm wavelength infrared LEDs. I made a prototype program that can track the infrared LED position in the capturing screen. Soon, I will start implementing the whole tracking system.

Difficulties

There are a lot of difficulties in this project, mainly related to my lack of knowledge and experience in computer vision field, and the uniqueness of the project.

Before this doing this project, I have neither done any project nor learn anything related to computer vision and infrared tracking. Hence, I spend extra time to do a lot of research, testing, and prototyping. I also need to learn about infrared related physics because this project highly relies on it. However, these works will not be wasted because it helps me to build a more efficient system and make less mistake in the future development.

Since Project Cortex is a very unique project which it has not done ever before, I have no predecessor to learn from or follow to. I must be highly self-driven so as to progress in this project. Luckily, I am very interested in this project field so I can use it as my motivation.

Current Activity

My current activity of Project Cortex is to test whether it will be better to use 850nm or 940nm wavelength infrared for the signal source and camera filter. 850nm wavelength LEDs can usually produce more powerful infrared light while 940nm wavelength filter can filter most noise signal. I have order some 940nm related equipment online and soon I will test it.

For the gimbal system, I bought 4 servo motors online and I started to write some controller interface for it. Also, I started to design the camera mount and gimbal system to allow myself to test the controller interface.

I also study a lot related to how people perform motion tracking, and process graphical data. With the research information I found, I should decide and finalize these items before actual implementation:

- 1) To or not to use second capturing device as supporting data source.
- 2) How to handle system robustness issue.