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作品名稱
鋼鐵擂台
Real Steel

隊伍名 稱
鋼鐵棒球 / Iron Baseball

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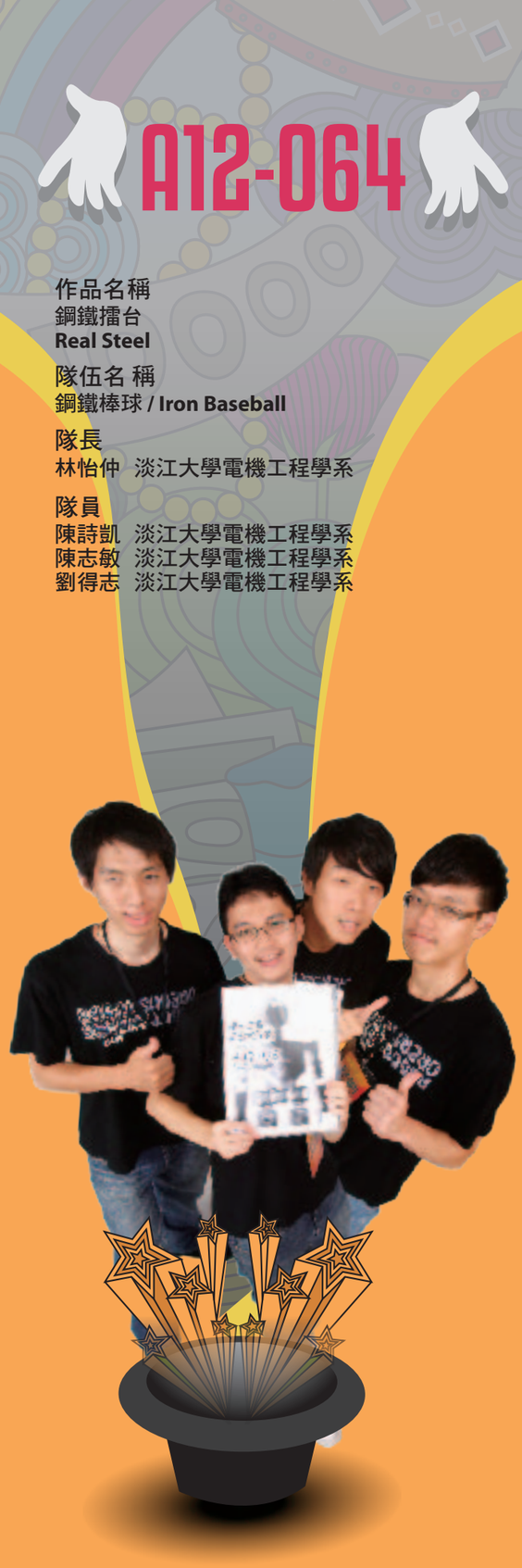

作品摘要

本作品使用兩台視覺自主的人形機器人來實現投手機器人可以投球與打擊機器人可以擊球的機器人打棒球之模擬賽事。在本作品中，由兩台人形機器人分別扮演投手與打擊者的角色，並且各自具備自主投球與自主打擊的能力。本作品的實現主要需要整合五大項：（1）機構、（2）電子電路、（3）影像處理、（4）人工智慧、與（5）動作設計等。在機構的設計上，人形機器人具有腳部、腰部、身體、手部以及頭部共23個自由度的設計；本作品更加強了能持球與拿球棒的手掌設計，讓人形機器人不但可以完成基本的肢體動作，更可以做出投球與揮棒的動作。在電子電路的設計上，本作品是透過一塊單板電腦TKICBoard與一塊FPGA開發板來組成計算核心系統；TKICBoard主要負責影像處理與策略判斷，而FPGA板則是負責處理機器人的運動控制；本系統同時應用了USB 2.0、RS-232串列埠、RS-485串列埠與GPIO等多種介面來實現資料傳輸與周邊控制。在影像處理的設計上，機器人需要將目標物件做特徵萃取與物件分割，透過分析目標物件的距離、位置等相關資訊來做為判斷動作執行的依據；投手機器人透過分析本壘區的影像來決定投球之位置，而打擊機器人則是透過分析球的連續影像來預測其位置進而執行打擊動作來將球揮出。在人工智慧的設計上，投手機器人會在一開始時建置一個虛擬的好球帶，並依照其好球帶的位置投出不同高度的球路；而打擊機器人則是透過球通過畫面的時間與位置來預測球的軌跡，以進行不同高度的揮擊動作。最後，在動作的設計上，本作品是分別依照投手機器人與打擊機器人的功能來設計出專屬的投球與揮棒的動作。在實驗結果中，本作品透過高度整合機構、電子電路、影像處理、人工智慧與動作設計等多項技術來完成機器人投球與打擊的棒球模擬賽事：投手機器人能順利將球投入好球帶以及打擊機器人能順利將球擊出。

Fig.1 > 兩台視覺自主的人形機器人來實現投手機器人可以投球與打擊機器人可以擊球的機器人打棒球之模擬賽事

Abstract

A baseball game of the humanoid robots including two vision-based autonomous humanoid robots is implemented in this project. The pitch and hitter robot are able to throw and hit the ball respectively. A complete progress of pitch and hit including: the pitch robot aims the strike zone, the pitch robot throw the ball, the hitting robot analyzes the ball trajectory, and the hitting robot swing the bat to hit the ball is accomplished in this system. In order to achieve this project, five topics are integrated: (1) mechanism, (2) electrical circuit, (3) image processing, (4) artificial intelligent and (5) motion design. In the mechanism design, there are 23 degree of freedom (DOF) arranged for the feet, the waist, the body, two hands, and the head. A special design is mounted on the hand for holding the ball and grabbing the bat. 4 DOF are designed for each arm. The robot is able to throw the ball and swing the bat as same as human. In the electrical circuit design, the central processing system consists of an IPC board named TKICBoard and a FPGA board. TKICBoard is used for the image processing and strategy decision, and the FPGA board is for the motion control. NIOS, a 32-bits CPU is used in the FPGA to manage the motion control. The I/O and transmit interface of the electrical circuit includes USB 2.0, RS-232, RS-485, and GPIO. In the image processing design, the robot detects the feature of the objects and segments the objects. The executed motion is decided by the measurement result of the distance and position information of the target object. The pitch robot analyzes the home plate image for the throwing motion; the hitter robot predicts the trajectory of the ball for the hitting motion. In the artificial intelligent design, in order to pitch well, the pitch robot simulates the strike zone based on the position of the home plate and changes the pitch motion. The hitter robot executes different swing motion based on the trajectory of the ball. In the motion design, there are several different pitch motions and different hitting motions are implemented for the pitch robot and hitter robot. A highly integrated system for the baseball game of the humanoid robots is accomplished in this project. Five topics including mechanism, electrical circuit, image processing, artificial intelligent, and motion design are integrated so that the pitch robot is able to throw a ball into strike zone and the hitter robot is able to hit the ball successfully.

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自1996年擔任淡江大學電機系教授迄今、淡江大學智慧自動化與機器人中心主任（2011/8/1迄今）、中華民國自動控制學會理事（2006/1/1迄今）、台灣機器人學會理事。（2008/1/1迄今）、台灣智慧自動化與機器人協會監事。（2011/7/5迄今）、淡江大學電機系教授兼系主任（2006/8/1~2010/7/31）。

研究領域

模糊系統、智慧型控制、SOPC設計、智慧自動化與機器人。