KURA – Extended Abstract for Humanoid Soccer Competition KidSize, RoboCup 2024 Eindhoven

Bushra Alshehhi[1], Ahmad Al Omari[1], Bushra Alzadjali[1], Naseeba Rehman[1], and Hamad Karki[1]

Khalifa University, Abu Dhabi, UAE `kurauae@gmail.com`
https://ku.events/robokup

Abstract. The paper highlights research interests of Khalifa University and team KURA itself and gives a brief overview of scientific aspects of KU's humanoid robotic system.

Keywords: RoboCup · Humanoid League · KURA.

1 Khalifa University

1.1 Introduction

Khalifa University of Science and Technology, internationally recognized for its top ranking, is the sole university in the UAE that offers comprehensive research and academic programs addressing the full spectrum of strategic, scientific, and industrial challenges inherent in the transformation of the UAE's knowledge economy and the dynamic global landscape. Khalifa University is known for its efforts to promote gender equality and diversity in STEM fields. The university has a strong focus on cutting-edge research in areas such as renewable energy, aerospace engineering, artificial intelligence, robotics, and health sciences. The goal is to contribute to the advancement of knowledge and address global challenges.

1.2 Robotics in KU

Khalifa University is currently at the forefront of several groundbreaking robotics projects, including initiatives focused on infrastructure inspection, extreme environment exploration, and industrial applications. In these projects, the university harnesses the power of robotics to address critical challenges in inspecting and maintaining vital infrastructures, navigating hostile environments, and optimizing industrial processes. The research at Khalifa University not only showcases technological advancements but also underscores a commitment to developing practical solutions that have a tangible impact on the world.

1.3   Interest in humanoid soccer

Khalifa University applies its expertise from diverse projects to integrate complex behaviors into humanoid soccer-playing robots. Insights gained from infrastructure inspection and extreme environment exploration projects enhance the adaptability and decision-making abilities of these robotic systems. The aim is to replicate nuanced movements crucial for soccer, including strategic decision-making, spatial awareness, and collaboration. By connecting these varied research areas, Khalifa University pioneers a holistic approach to humanoid robotics, unlocking possibilities for intelligent, versatile robots applicable beyond soccer to various practical scenarios.

2   Team KURA's humanoid robotic system

2.1   Vision

Stereo Vision and neural networks Robot vision system combines classic vision approaches with machine learning techniques.

A custom stereo vision arrangement, employing two wide-angle cameras, is implemented to generate a point cloud. This point cloud serves the purpose of identifying obstacles within a close range.

An optimized neural network detects different kind of balls and robots to understand the situation on the whole field. This helps to make strategy decisions.

Localization Robot is able to localize itself on the field. Vision system takes into account objects like white lines, their intersections and goalposts.

2.2   Strategy

Behavior The heart of the behavior system is a hierarchical finite state machine approach. High level behavior controls low-level skills that responsible for creating motion.

Referee and Team communicaton The robot is able to communicate with RoboCup GameController and follow the states of the game.

Several robots play in team-like style. Each robot has it own role in the game. Data they communicate: robot position on the field, detected objects, team decisions.

2.3   Motion

Trajectory planning and walk The robot is able to walk in any direction and stabilize itself. Walking trajectory calculates each step and is able to avoid obstacles such as other robots or goalposts.

Kick and standups Other low-level skills are made in animation-like manner.