(IE) Industrial Electronics

(CAR) Control, Automation and Robotics

CENTROALGORITMI

(LAR) Laboratory of Automation and Robotics

Minho Team

NEW THRUST ON MINHO TEAM

Universidade do Minho
Escola de Engenharia

COMPETE

QREN

União Europeia

FCT Fundação para a Ciência e a Tecnologia

car control automation and robotics

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Guimarães - PORTUGAL
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MINHO TEAM

CENTROALGORITMI

Fernando Ribeiro

Team Leader
RoboCup Trustee

Gil Lopes

Team Leader
Chief Engineering

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MINHO TEAM

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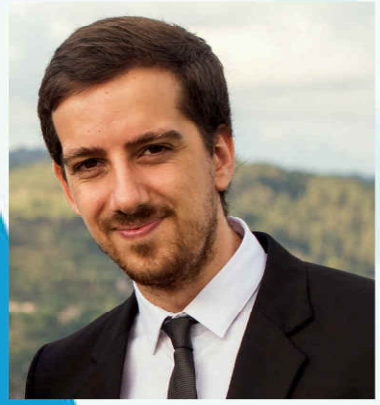
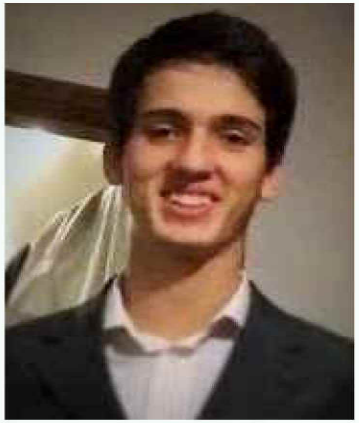
Hélder Ribeiro



Artificial Intelligence,
Tactics & Strategy

Pedro Osório



Vision & Calibration
3D ball Recognition/Goalkeeper

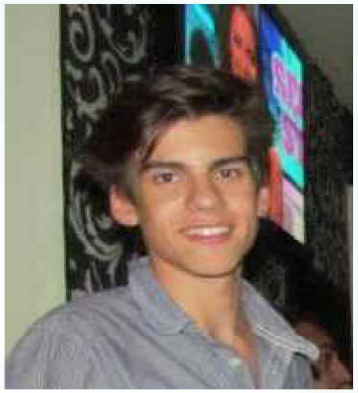
Tiago Maia

Motion Dynamics
Motion Planning

André Gomes

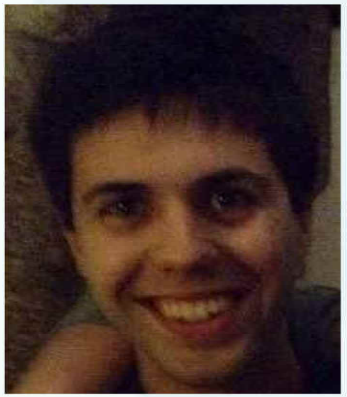
Power electronics
Hardware

Ricardo Roriz



RTDB
Communications

Nuno Ferreira



Ball Reception Mechanism
Mechanical Engineering

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Evolution of Minho Team

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- Started in 1997
- Participations in RoboCup events from 1997-2011
- New set of students in 2014, mainly rebuilding the robots
- Aiming to participate in RoboCup'2016

2015

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MINHO TEAM ROBOT

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HEAD

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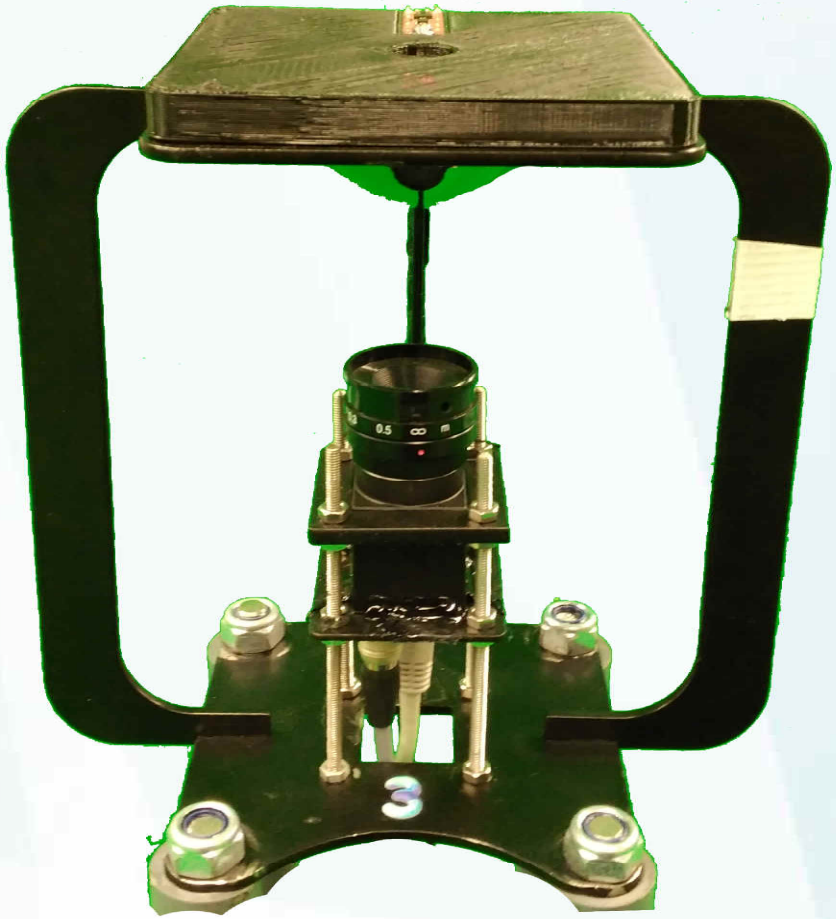
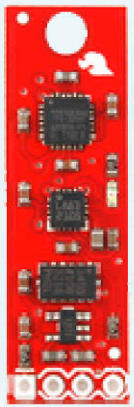
BFLY-PGE-13S2C-CS

Lens



Curved Mirror

9 Degrees of Freedom - IMU



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BASE LAYER ONE

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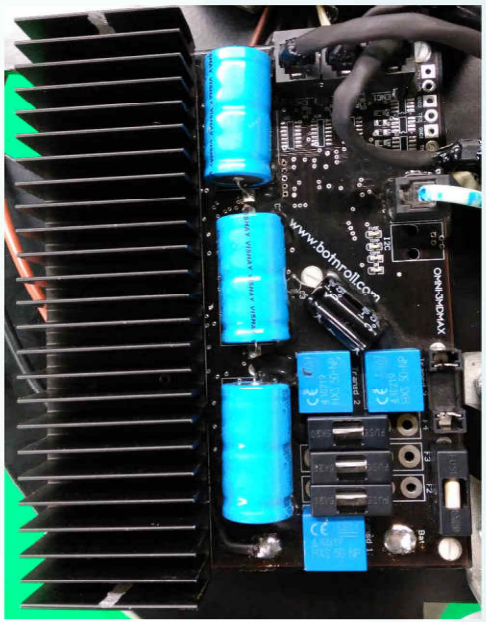
12,6 V 4400mAh LiFe Battery

x3



OMNI 3MD
Omni-directional
Motor
Controller

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BASE LAYER TWO

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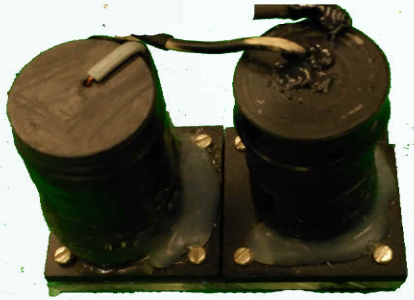
Kick Capacitors

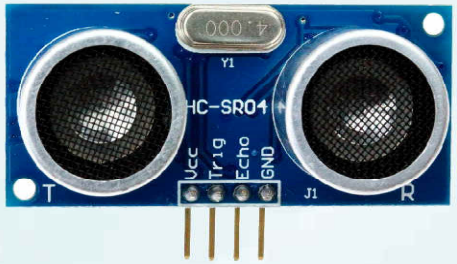
Hardware Controller Box

Charge/Discharge Capacitors

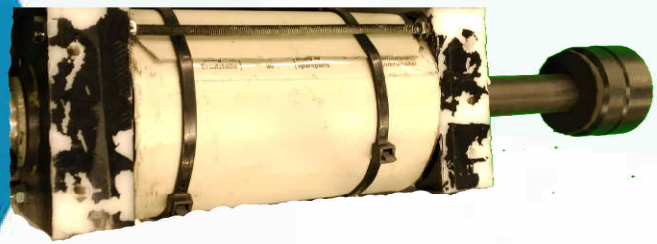
Inductor



Sonar Ball Detector



Kick Inductor



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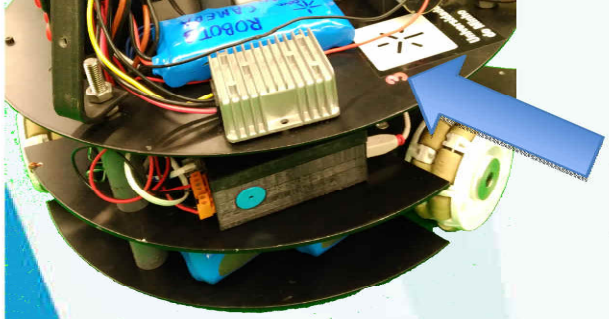

BASE LAYER THREE

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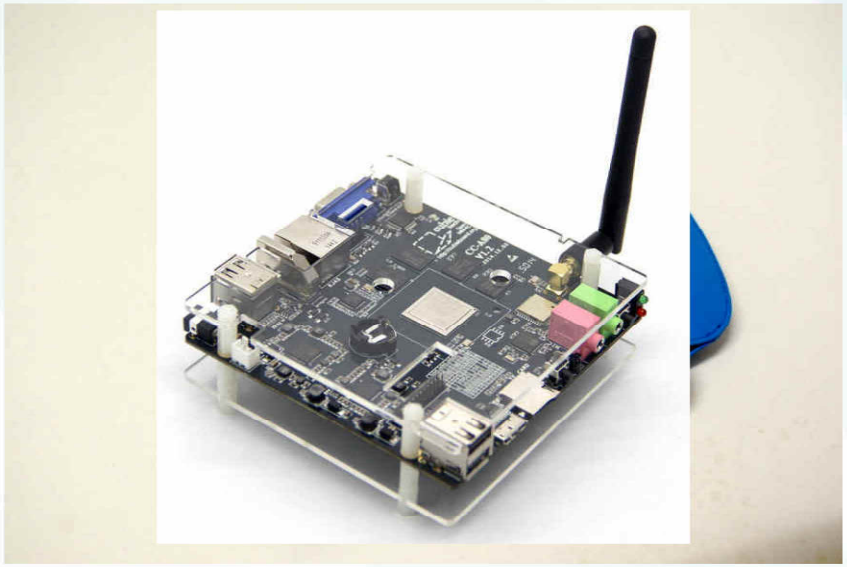
Power Box

Kick's Type Inductor

Mini-PC



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LOCALIZATION

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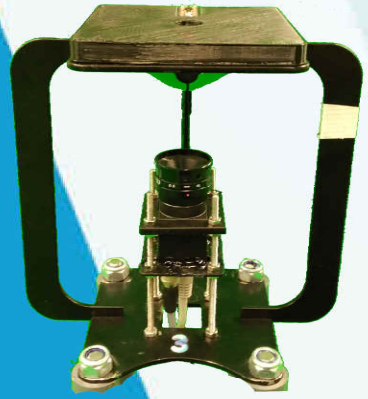

Image Acquisition

Image processing to detect line points using radial scan lines

Odometry

IMU Heading Angle

Error Minimization in a local area

► Local and Global localization operate in the same way.

Final Self-Localization Estimate

Data Fusion using a Kalman Filter

► Future Work

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LOCALIZATION

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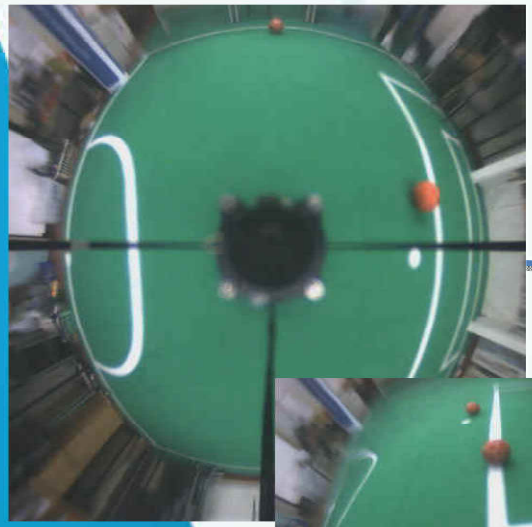
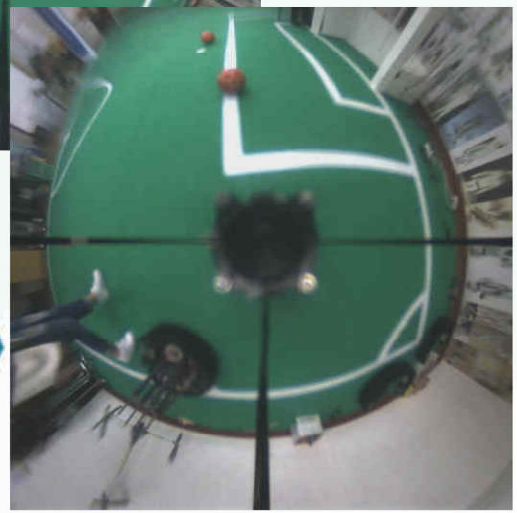
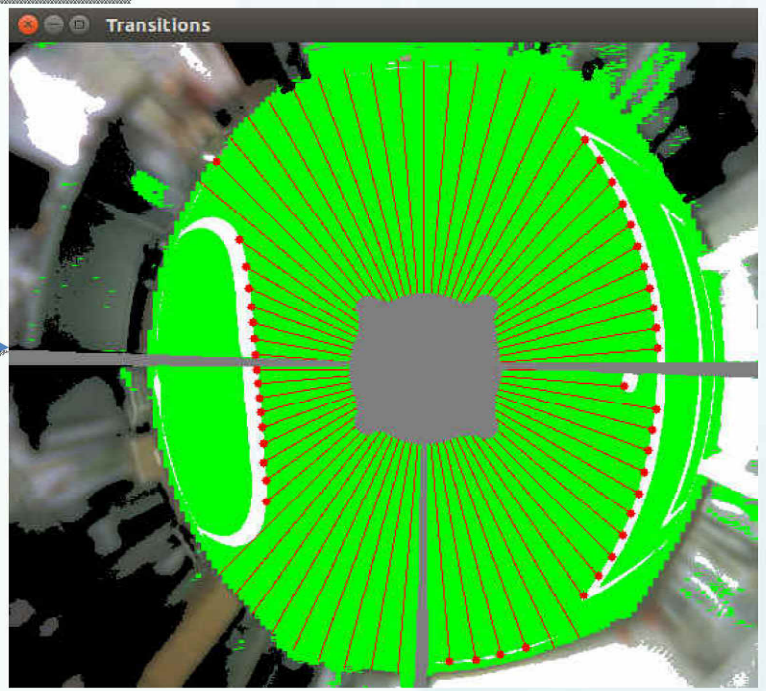
Image Acquisition → Image Segmentation/Scan Lines Segmentation → Field-Line Transitions → Detect Line Points







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POSE ESTIMATION

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PROCEDURE:

- 72 radial scan lines, one each 5º.
- Pre-generated file with the closest line point in every 72 directions.
- Detect line points using the scan lines.
- Compare the detected line points with the pre-generated ones to find the least error.
- Locally or Globally, what changes is the range of comparison with the pre-generated "Field-Map" file.
- Obtain data from odometry.

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PROBLEMS AND SOLUTIONS

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Problems Experienced:

•Without the Kalman Filter, the vision estimator produces erroneous "jumps".

•Exterior light interference, causing "false-positives" in line point detection.

•Bad calibration of image segmentation and image-to-world distance mapping , produce large errors in the estimate.

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PROBLEMS AND SOLUTIONS

CENTROALGORITMI

Future Solutions:

•Use odometry and a Kalman filter, to filter out jumps and smooth the pose estimate.

•Better calibration of the camera itself and catadioptric mirror improvement.

•Create a software to calibrate image-to-world distance mapping and image segmentation algorithms and values.

•Adaptation of “Calculating the Perfect Match” by *Brainstormers Tribot.*

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SELF-LOCALIZATION EXAMPLES

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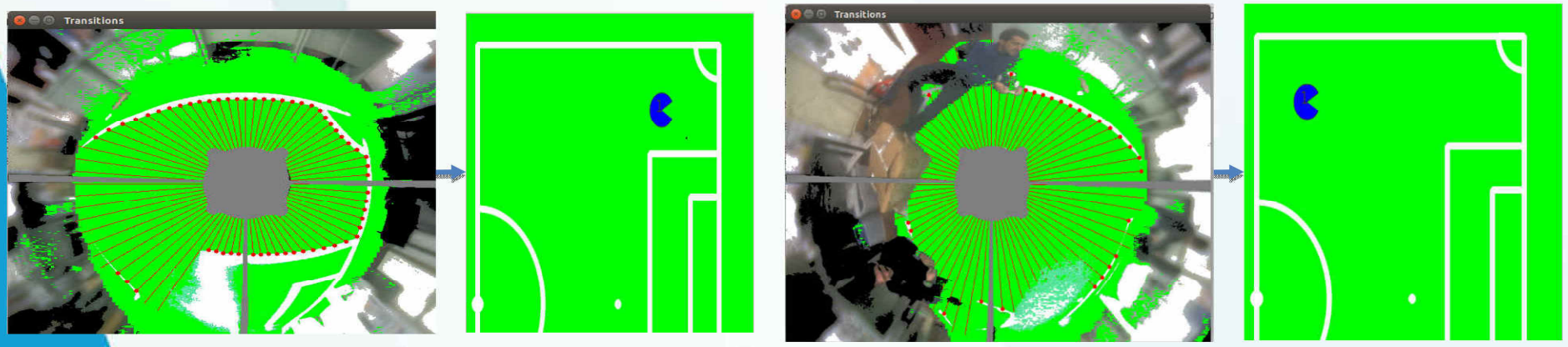

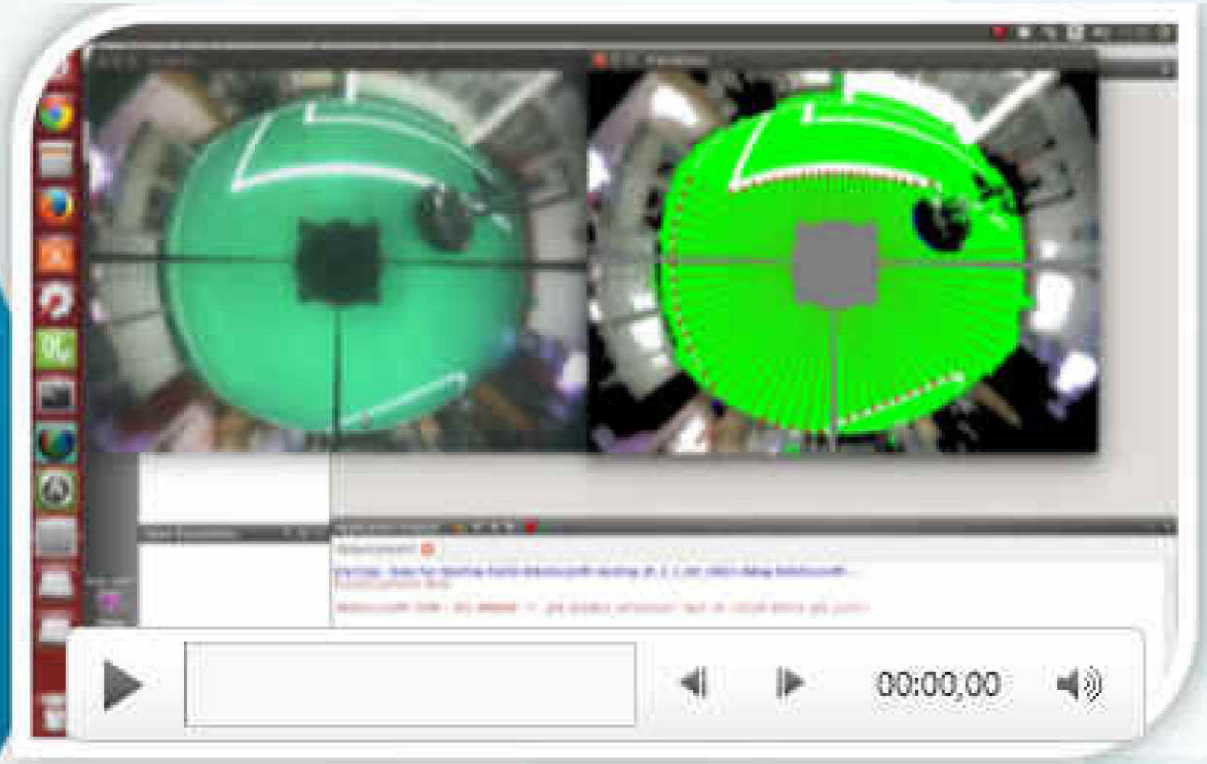

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3D Ball Recognition using Kinect

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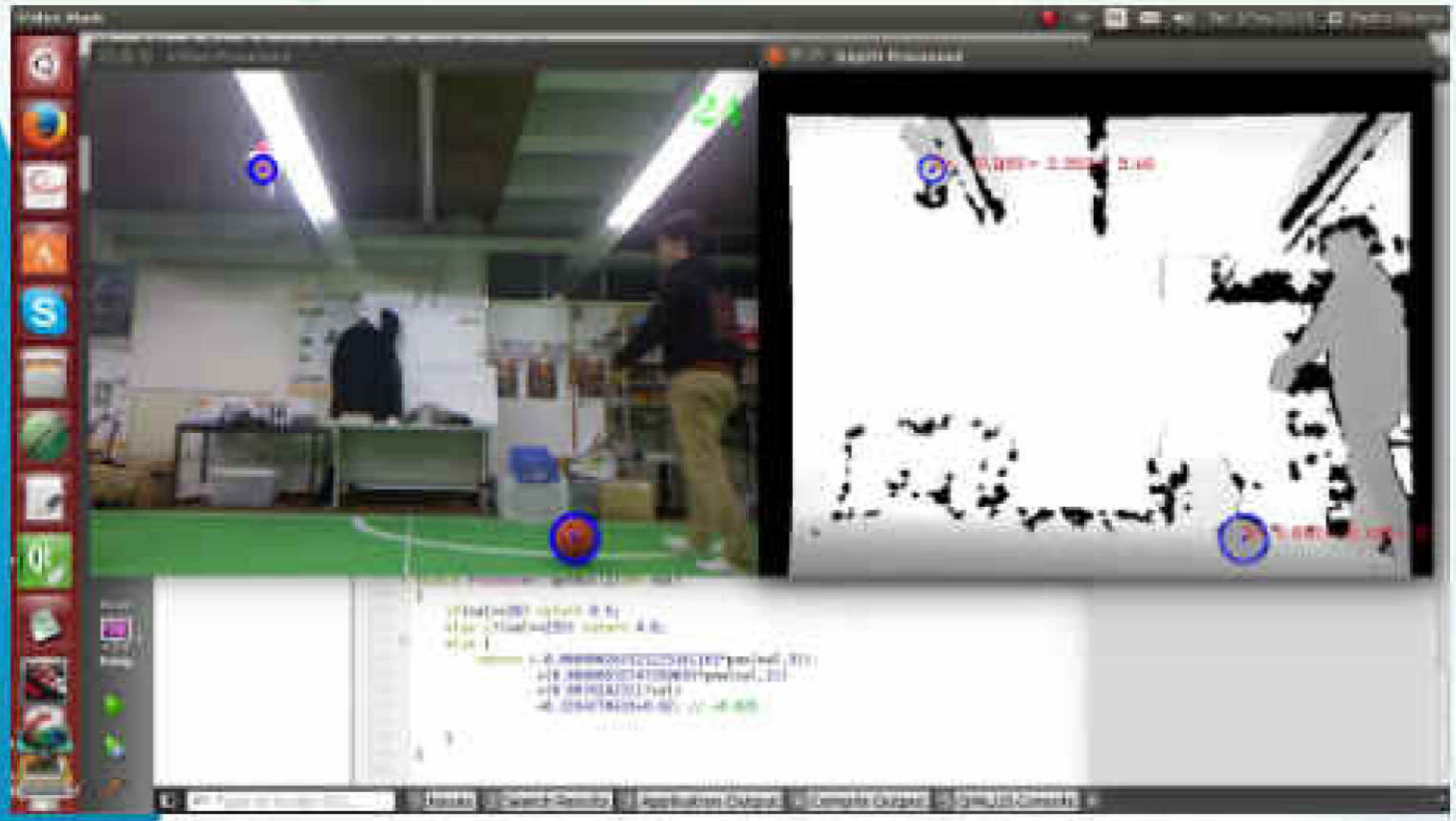
Image Acquisition → Image processing to detect ball candidates → Filter candidates using geometric relationships → Use 3D image to obtain ball's 3D coordinates



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Future Work in Goalkeeping

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- Better filtering in the candidates list using more morphological comparisons.
- Use of a Kalman Filter to predict ball movement and produce a future estimate of where the ball will cross the goal-line.

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Future Work in Goalkeeping

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- Active goalkeeping based on human goalkeepers positioning and game-sense.
- Build of goalkeeping structure, as in this stage, we don’t have any.

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Questions?

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Thank you for your attention

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