Driving Matter 2.0

Autonomous Marker-Less Augmented Reality Based Car Simulation using Deep Reinforcement Learning

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Waqas Ali

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Outline

Introduction

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- Virtual car agent using Unity and AR-Foundation.

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- Environment setup for interaction and rewards using virtual diamonds.

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- Virtual car agent using Unity and AR-Foundation.
- Environment setup for interaction and rewards using virtual diamonds.
- Real-time collision detection and avoidance with real world obstacles.
- Implementation of Reinforcement Learning models for developing an Autonomous car.

FYP-1 Objectives

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- Plane Detection.

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- Creation of a user controllable virtual car.

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- Plane Detection.
- Creation of a user controllable virtual car.
- Creation of a suitable environment containing virtual diamonds and Goal Flag.

Use Case Diagram

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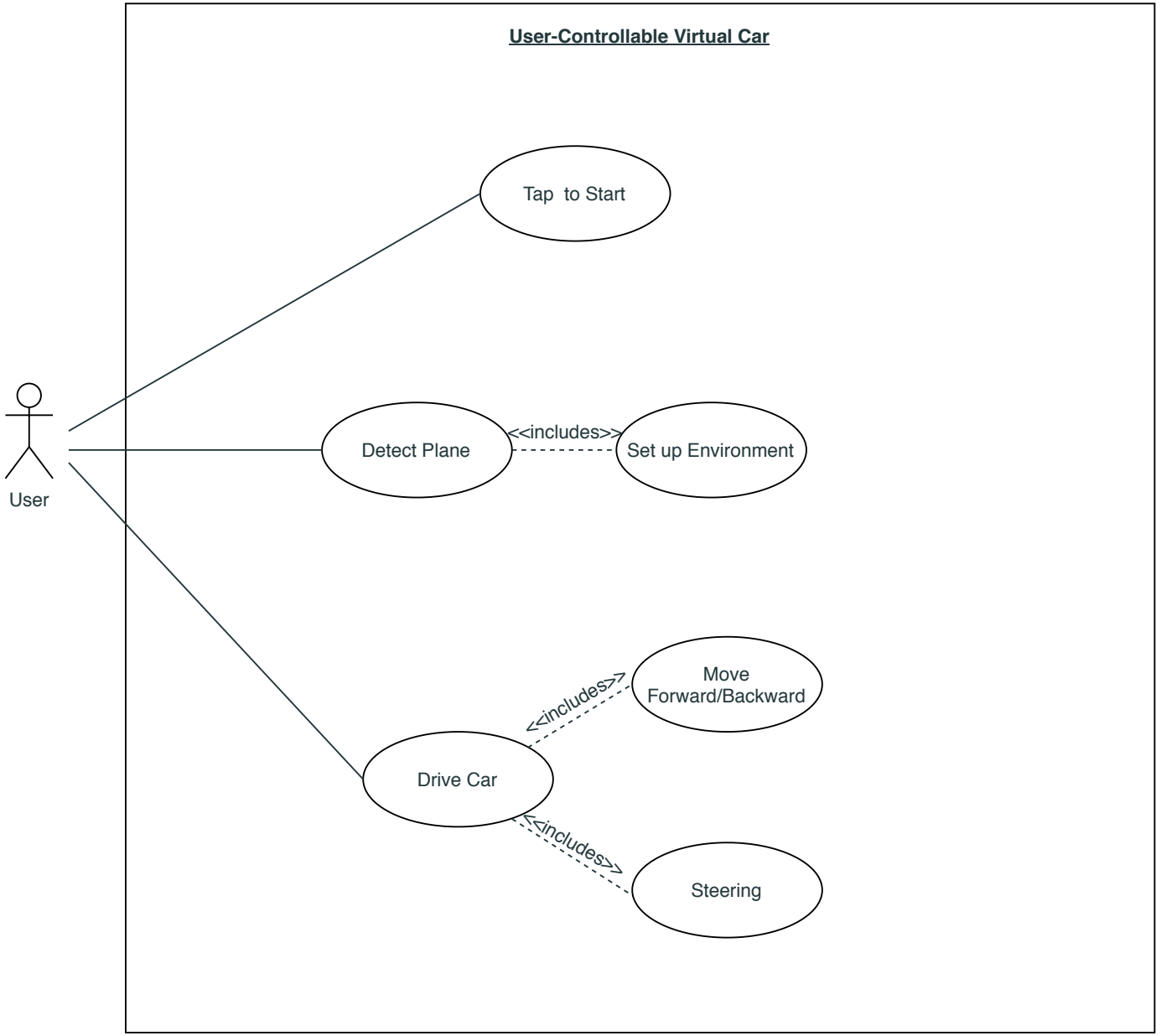

System Work Flow

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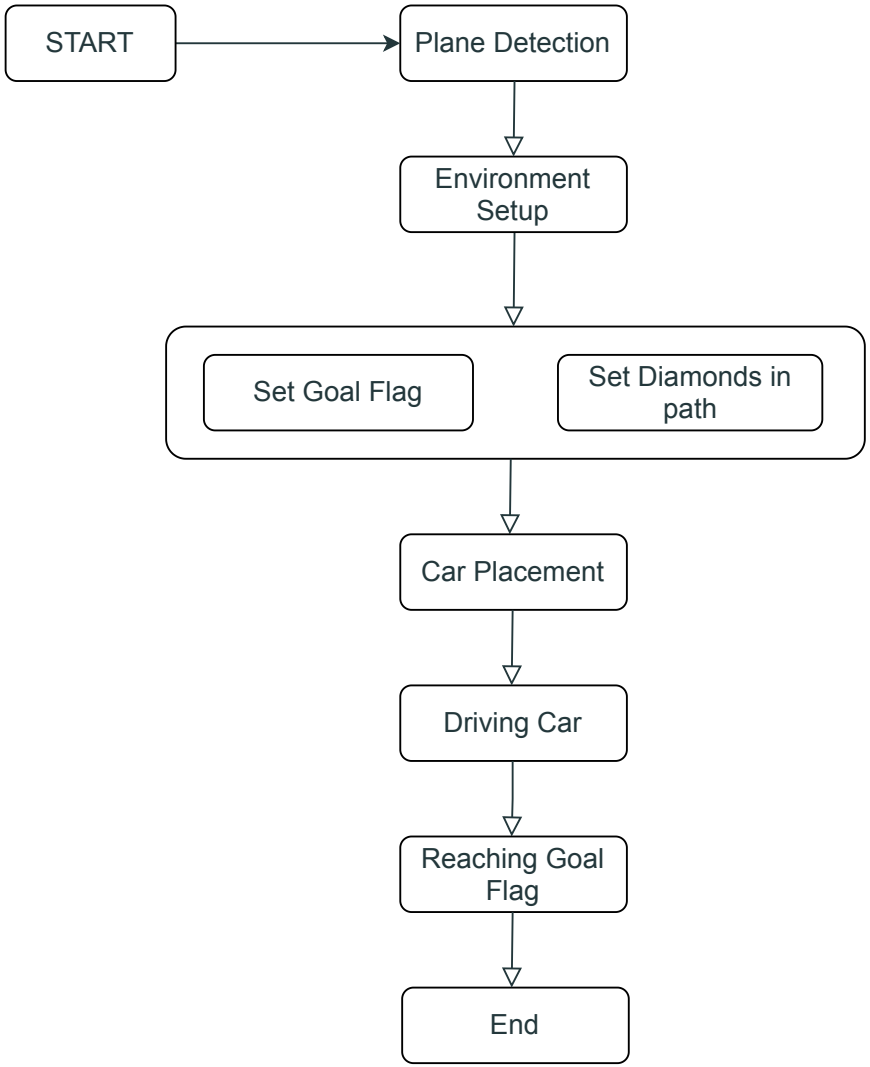
Flow Chart



Literature Review

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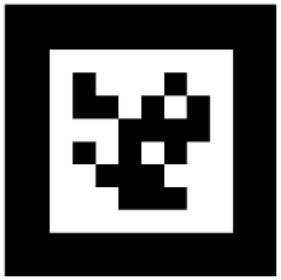
Marker-Based VS Markerless

(a) Augmented Reality application running on a smart-phone

(b) Template Marker



(c) Bar-code Marker

(d) Circular Marker

- Depends on Markers

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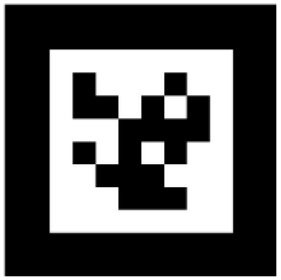

(c) Bar-code Marker

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- Depends on Markers
- Exposure of light

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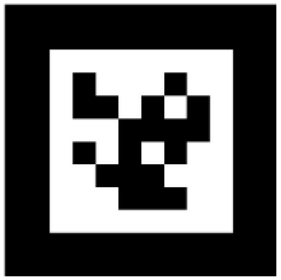

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- Depends on Markers
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- Partial occlusion of markers

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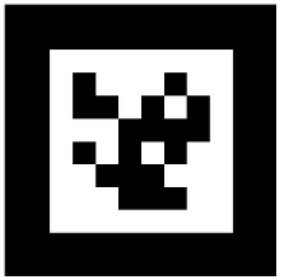

(c) Bar-code Marker

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- Depends on Markers
- Exposure of light
- Partial occlusion of markers
- Desktop and mobile support

Marker-Based VS Markerless

- Depends on Localization and Mapping

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- Gyroscope and Accelerometer
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Demo

Plane Detection

- Motion tracking

Plane Detection

- Motion tracking
- Environmental understanding

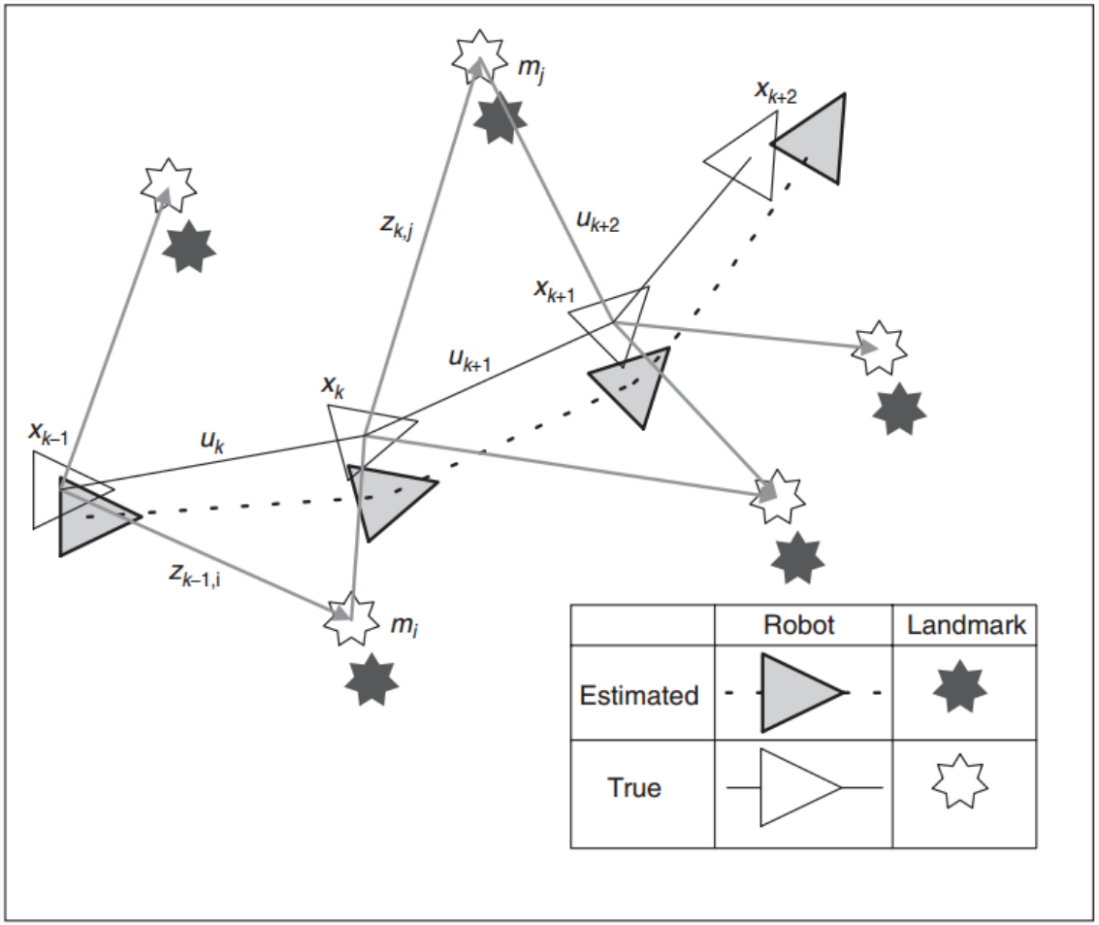
Plane Detection

- Motion tracking
- Environmental understanding
- Depth understanding

Plane Detection

- Motion tracking
- Environmental understanding
- Depth understanding
- Light estimation

Simultaneous Localization And Mapping (SLAM)



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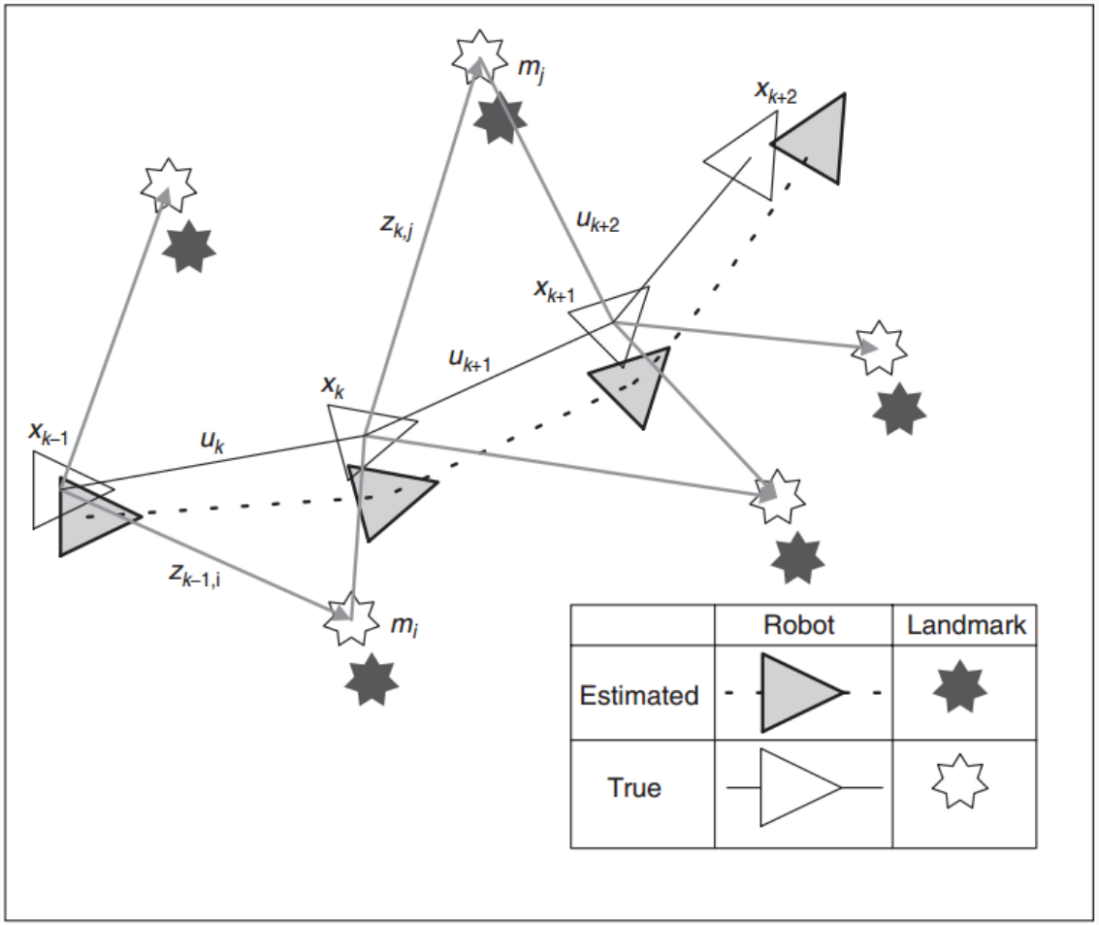

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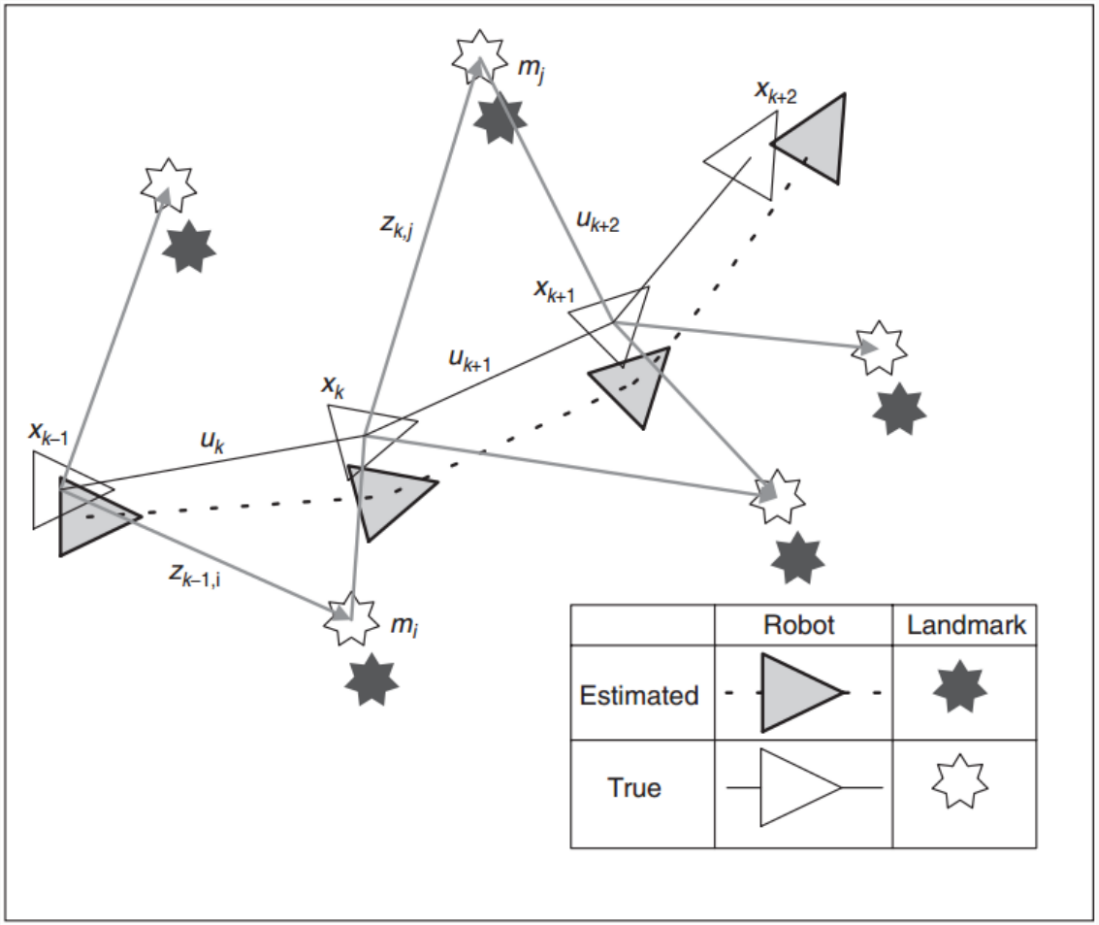

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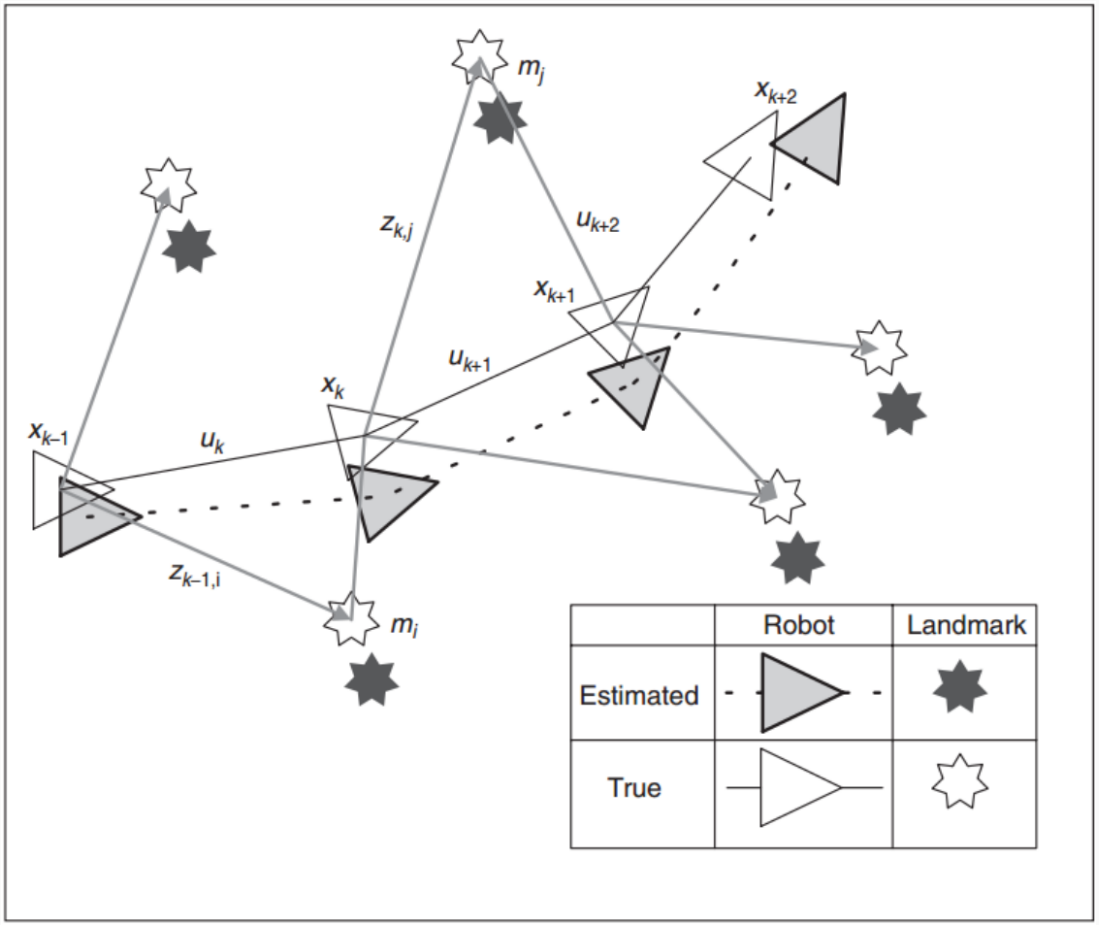

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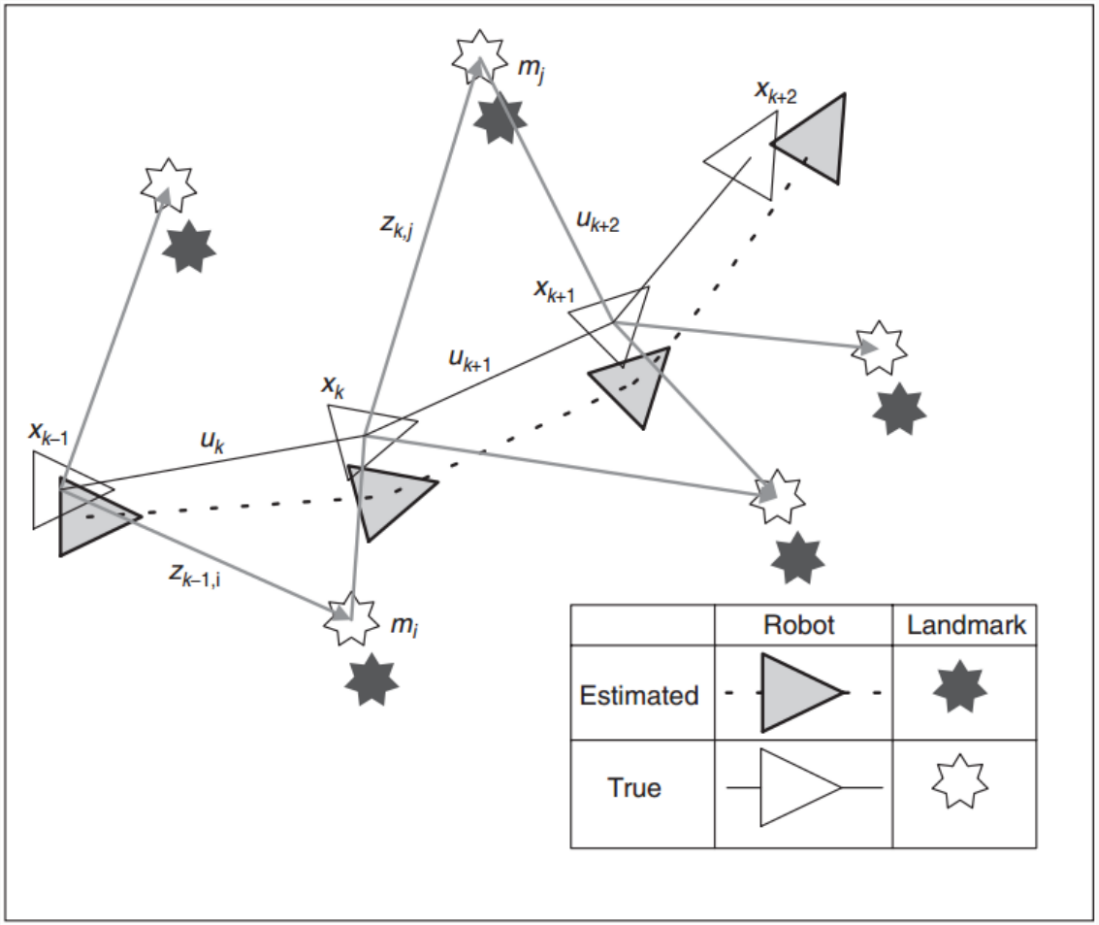

- x_k : the state vector describing the location and orientation of the device at time k.
- u_k : the control vector applied the time k-1.
- m_i : a vector describing the location of the i^{th} landmark. The landmarks are motionless.
- z_{ik} : an observation taken from the device of the location of the ith landmark at time k.

SLAM (cont)

SLAM Equation to estimate most recent pose and map
[5]

$$p(x_t, m|z_{1:t}, u_{1:t}) = \int \int \dots \int p(x_{1:t}, m|z_{1:t}, u_{1:t}) dx_1 dx_2 \dots dx_{t-1}$$

Integrations (marginalization) typically done one at a time.

Progress

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- Game Development in Unity 3D

Progress

- Game Development in Unity 3D
- AR-Foundation

Questions!

References

References

[1] W. Viyanon, T. Songsuittipong, P. Piyapaisarn, and S. Sudchid, "Ar furniture: Integrating augmented reality technology to enhance interior design using marker and markerless tracking," in *Proceedings of the 2nd International Conference on Intelligent Information Processing*, 2017, pp. 1–7.

[2] I. Y. Chen, B. MacDonald, and B. Wünsche, "Markerless augmented reality for robots in unprepared environments," in *Australasian Conference on Robotics and Automation. ACRA08*, 2008, pp. 3–5.

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[3] O. Oda, L. J. Lister, S. White, and S. Feiner, "Developing an augmented reality racing game," in *Proceedings of the 2nd international conference on INtelligent TEchnologies for interactive enterTAINment*, 2008, pp. 1–8.

[4] Y. Chong, D. K. Sethi, C. H. Y. Loh, and F. Lateef, "Going forward with pokemon go," *Journal of emergencies, trauma, and shock*, vol. 11, no. 4, p. 243, 2018.

[5] H. Durrant-Whyte and T. Bailey, "Simultaneous localization and mapping: Part i," *IEEE robotics & automation magazine*, vol. 13, no. 2, pp. 99–110, 2006.