POPPY THE WATCHDOG

Applied Reinforcement Learning 2016
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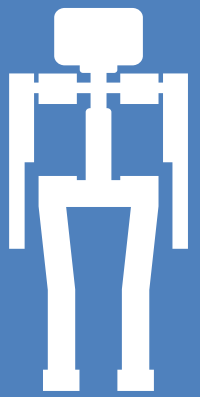

Image: References (left to right):
1) https://pixabay.com/de/sicherheit-wort-laser-modern-574079/ 2) https://pixabay.com/de/sicherheit-sicherheitskonzept-augen-1163108/
3) https://pixabay.com/de/objektiv-linse-null-eins-bin%C3%A4r-1278493/ 4) https://pixabay.com/de/sicherheit-wort-laser-modern-574079/

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Introduction and Motivation

What

- Point its weapons (i.e. robot arm) only towards hostile intruders
- Welcome allies with a friendly greeting
- Emulation using colored cards
- Implement the procedure using reinforcement learning
- **Overall goal: finding a policy that allows the Poppy robot to locate a target by only moving its head, to fix the object in the center of its vision.**

Why

- Detection and tracking are important problems in autonomous systems
- Using machine learning methods we can achieve more complex or dynamic behaviour

Image: https://pixabay.com/de/idee-antwort-erleuchtung-klugheit-1026393/

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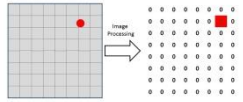
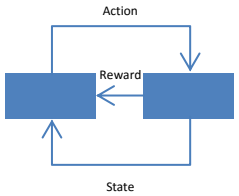
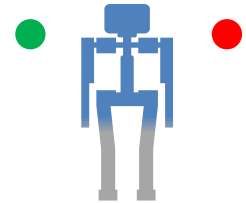
Overall goal: Acting properly

POPPY THE WATCHDOG

Subgoal	Tasks and Steps	

Classifying image data and object localization	**Computer Vision Task**
	▪ Collection of reference images (i.e. images of colored cards or items)
	▪ Algorithm research
	  ▪ Color Segmentation
	  ▪ Localization
	▪ Algorithm Testing and Implementation
		

Finding optimal state-action policy	**Reinforcement Learning Task** ▪ State and action space formulation ▪ Reward design ▪ Learning Algorithm and Implementation ▪ Simulation (VREP)	
Making Poppy what the simulator does	**Practical Implementation** ▪ Mechanics and Control ▪ Transfer of Algorithms on Poppy ▪ Performance Evaluation	

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Project plan - visualized using a Gantt-Chart

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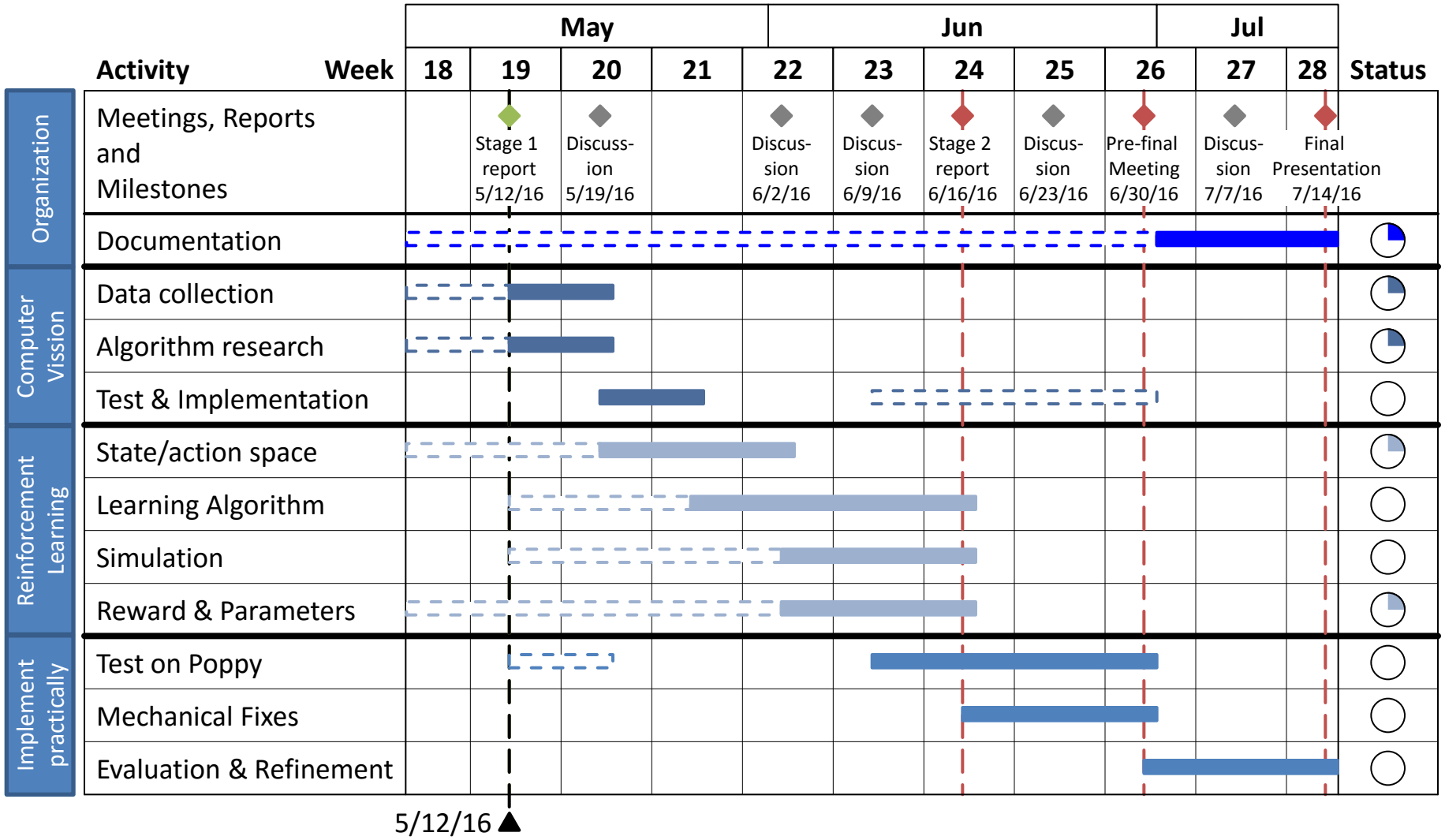

Task distribution

POPPY THE WATCHDOG

Computer vision → Reinforcement Learning → Practical Implementation

Step / Subtasks	Who	Deadline
COLLECTION OF REFERENCE IMAGES		
▪ Write a python script that makes poppy perform predefined rotational movements taking images of the environment	Z	19/05
▪ Take reference images using the aforementioned algorithm	Z/B	19/05
ALGORITHM RESEARCH		
▪ Search for color-segmentation solutions and the python APIs (naiv-channel difference, k-means-segmentation etc.)	B	19/05
▪ Search for a center detection algorithm	E	19/05
TESTING AND IMPLEMENTAION		
▪ Find possibilities to implement these algorithms in python using APIs and libraries or write the code directly.	E/B	26/05
▪ Test the algorithms offline using reference images.	Z/E	26/05
▪ Test the algorithms online with poppy and verify the accuracy of the result (i.e. are poppy images correctly mapped to states)	E/B	26/05

Image: Reference: https://pixabay.com/de/umzug-tragen-schrank-treppe-hoch-1015581/

Task Distribution

POPPY THE WATCHDOG

Computer vision | **Reinforcement Learning** | Practical Implementation

Step / Subtasks	Who	Deadline
STATE AND ACTION SPACE FORMULATION		
▪ Create artificial states that will be used as input data to the simulator (the artificial states can be generated based on the images taken with poppy and based on geometrical reasoning)	B/E	02/06
LEARNING ALGORITHM AND IMPLEMENTATION		
▪ Create a python default template (i.e. import relevant modules, define objects and respective default values for actions, states, rewards, value function) to allow for simple coding.	Z	16/06
▪ Create a function prototype for a function that returns an action according to a policy	E	16/06
SIMULATION (VREP)		
▪ Try several learning algorithms with the predefined setup and make them run properly on VREP using the artificial states as an input sequence.	E/Z/B	16/06
▪ Compare the different learning algorithms based on stability, robustness and speed in the simulator	E/Z/B	16/06
REWARD DESIGN		
▪ If necessary do an additional tuning of the rewards or the discount factor using the previously created funcions.	E	16/06

Image: Reference: https://pixabay.com/de/umzug-tragen-schrank-treppe-hoch-1015581/

Task Distribution

POPPY THE WATCHDOG

Computer vision → Reinforcement Learning → **Practical Implementation**

Step / Subtasks	Who	Deadline
MECHANICS AND CONTROL		
▪ Implement algorithm prototypes (from the Reinforcement learning task) on poppy and identify, if the performance/behaviour largely deviates form the VREP simulation	E/Z/B	30/06
TRANSFER OF ALGORITHMS ON POPPY		
▪ Identify possible mechanical issues and create fixes (e.g. lock the poppy torso in place)	B	30/06
PERFORMANCE EVALUATION		
▪ Evaluate the performance and possibly improve the algorithm using simulation and real poppy robot.	E/Z/B	14/07

Image: Reference: https://pixabay.com/de/umzug-tragen-schrank-treppe-hoch-1015581/

Task Distribution

POPPY THE WATCHDOG

Computer vision → Reinforcement Learning → Practical Implementation

Step / Subtasks	Who	Deadline
MECHANICS AND CONTROL		
▪ Implement algorithm prototypes (from the Reinforcement learning task) on poppy and identify, if the performance/behaviour largely deviates form the VREP simulation	Group	30/06
TRANSFER OF ALGORITHMS ON POPPY		
▪ Identify possible mechanical issues and create fixes (e.g. lock the poppy torso in place)	Ben	30/06
PERFORMANCE EVALUATION		
▪ Evaluate the performance and possibly improve the algorithm using simulation and real poppy robot.	Group	14/07

Documentation will be handled by all group members continuously but mainly from 01/07 to 14/07

Image: Reference: https://pixabay.com/de/umzug-tragen-schrank-treppe-hoch-1015581/

BACKUP

Module: Computer Vision Task

BACKUP

Recent Results

- Result 1
- Result 2
- Result 3
- Result 4
- Result 5

Risks

- Risk 1
- Risk 2
- Risk 3
- Risk 4
- Risk 5

Upcoming Tasks

- Task 1
- Task 2
- Task 3
- Task 4
- Task 5

Subgoal / Step	
Computer Vision Goal 1	
Computer Vision Goal 1	
Computer Vision Goal 1	
Computer Vision Goal 1	
Computer Vision Goal 1