



TACTICAL DIGITAL TWIN
RL FOR FOOTBALL STRATEGY

Tactical Digital Twin in Football

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Problem introduction

Modern football analysis fails to objectively evaluate the complex, real-time tactical contribution of players on the pitch.

Our project delivers a Tactical Digital Twin solution that uses advanced reinforcement learning and self-play to discover and optimize next-generation football strategies.



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Problem introduction

'What happened'

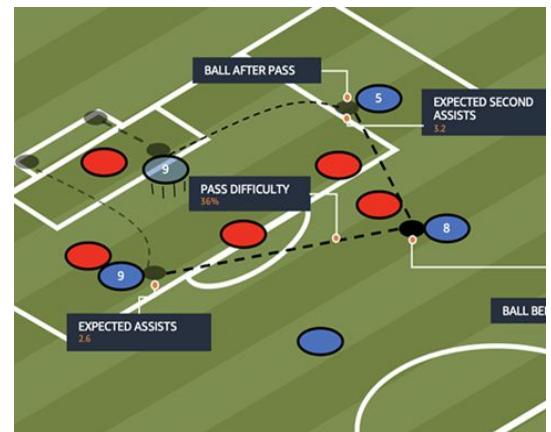


Digital twin



RL

'What can happen'



Descriptive analytics

Predictive & Prescriptive analytics



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Value proposition

This project supports **Goal 9 (Industry, Innovation, and Infrastructure)** by promoting cutting-edge AI applications in the sports engineering sector, helping to improve infrastructure and innovation in performance optimization technologies.

Target 9.5: Enhance Research and Upgrade Industrial Technologies.

Target 9.4: Upgrade All Industries and Infrastructures for Sustainability.





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Objectives



Develop a reproducible framework (digital twin) under realistic constraints, using real or synthetic data



Apply AI techniques to **simulate and optimize tactical behaviors**



Integrate real tracking or event data for **validation and calibration**



Design evaluation metrics to assess tactical effectiveness and realism

Stakeholders



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Michael J. Andersen

Head Coach

Former Midfielder; UEFA Pro License
15 Years of Coaching Experience

User Persona



GOALS

- Build a consistent tactical identity
- Make confident, evidence-based match decisions
- Improve team organization in pressing, build-up, transitions

NEEDS

- Clear interpretation of match performance
- Automatic recognition of tactical patterns
- Coach-friendly visuals for team briefings
- Quick evaluation of alternative tactical choices

FRUSTRATIONS

- Tactical insights take too long to extract from matches
- Hard to connect raw data to clear, actionable coaching decisions
- Limited time to explore alternative tactical options

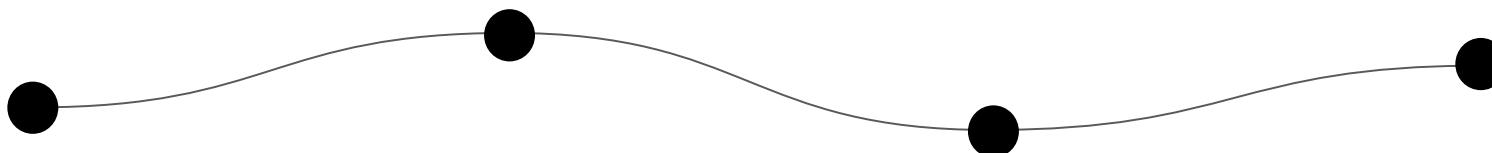


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Michael's Journey

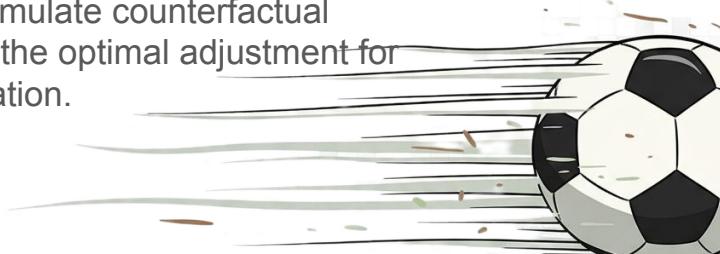
Michael searches for tools capable of connecting raw data to clear decisions, but it's not easy to find a platform that offers quick quantitative validation of alternative tactics.

Michael exploits the evidence-based results to make a confident decision and uses the clear, coach-friendly visuals to drive team briefings, boosting player compliance and loyalty to his strategy.



Michael is frustrated after a key match loss, he gathers insights on his high-press failure, but the manual data is exhausting, and the conclusions are often inaccurate and not actionable.

Michael decides to use a new analysis system, reportedly being developed by Politecnico di Torino, to rapidly simulate counterfactual scenarios and test the optimal adjustment for his team's organization.



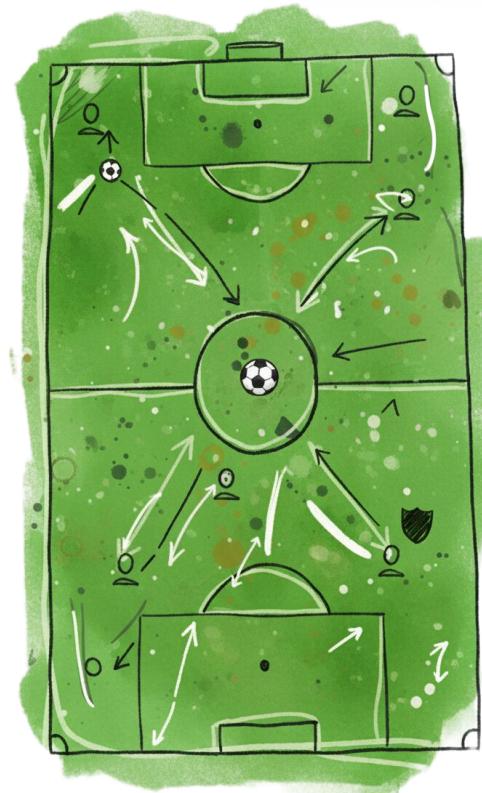
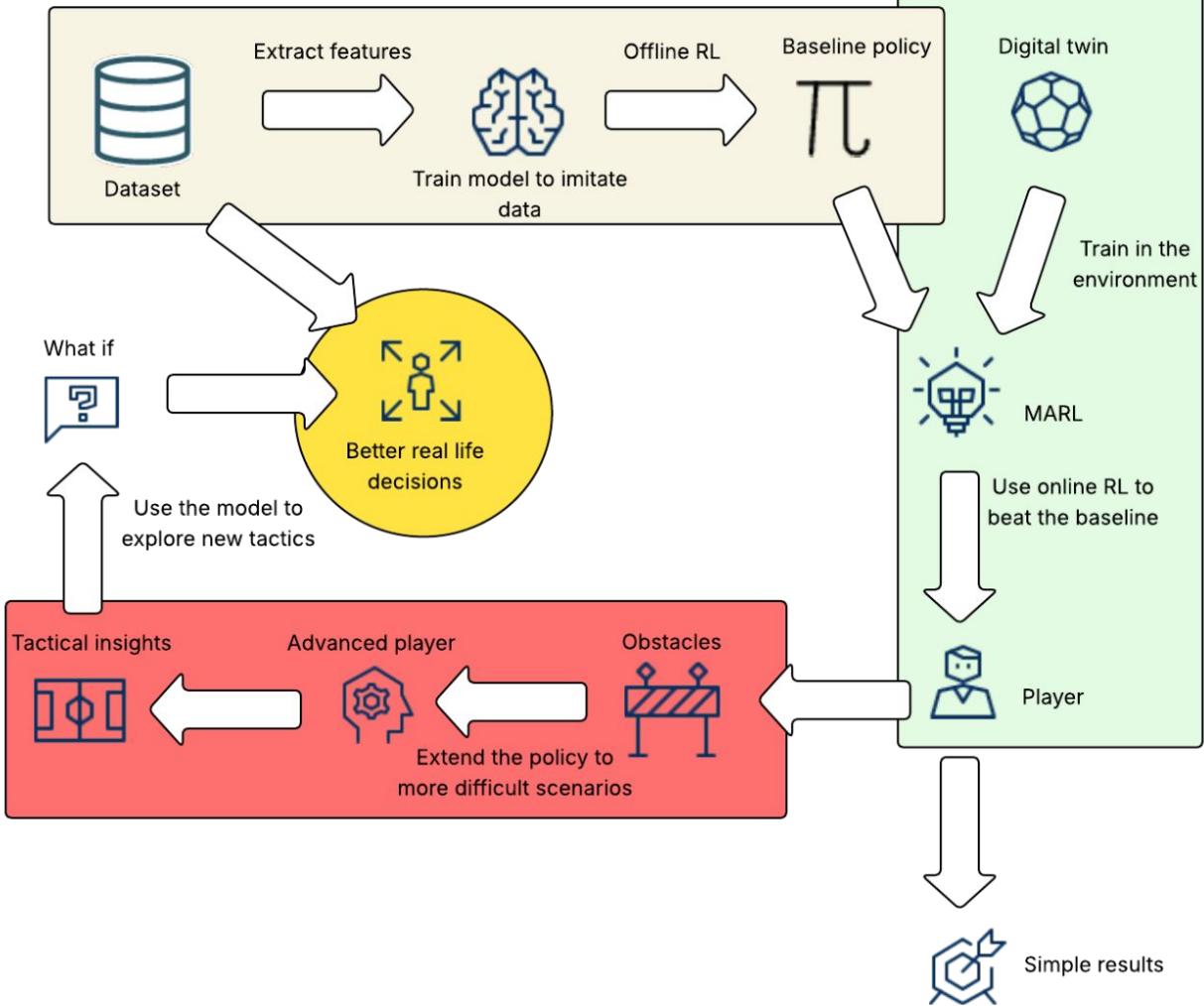


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User Requirements

		FUNCTIONAL	NON-FUNCTIONAL
M	MUST HAVE	Quantify: the system must simulate and generate quantitative results on the effectiveness of alternative tactical choices and counterfactuals.	Robustness: the system must demonstrate robustness by operating reliably across different datasets, tactical scenarios, and execution conditions, ensuring that core functionalities remain stable even when inputs or environments vary.
S	SHOULD HAVE	Visualization: the system should visualize simulated scenarios and key performance indicators in a coach-friendly format for easy presentation in team briefings.	Usability: The system should offer Clarity through an intuitive interface and coach-friendly visuals for quick interpretation and effective team briefings.
C	COULD HAVE	Optimize: the system could adjust decision models, and provide parameter tuning tools to optimize tactical behaviors.	Adaptation: the system could adapt to different tactical styles, data conditions, or evolving project goals, remaining useful as new strategies, behaviors, or analysis needs emerge.
W	WON'T HAVE	Analyze: the system won't offer real-time race strategy recommendations, focusing only on analyzing completed scenarios.	Exclusion: the system won't include physiological modeling, sports medicine features, or other non-essential components unrelated to tactical simulation.

Functional Diagram





Work breakdown structure

WP No.	WP Title	Lead Name	PM	Start Month	End Month
1	Project Management	M	0.5	November	November
2	Research	A	0.5	November	November
3	Data and Environment exploration	L	0.75	November	December
4	RL offline model	M	1.5	November	December
5	MARL online model	A	1.5	November	January
6	Documentation	L	0.5	November	January



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PACKAGE	TASK	Checkpoint 1			Checkpoint 2			Checkpoint 3			Final Presentation	
		week 1	2	3	4	5	6	7	8	9	10	11
Project management	Objectives	Green										
	Design		Green									
	Plan			Green								
	Presentation											
Research	Literature review			Blue	Blue	Blue						
	Problem understanding				Blue							
	RL study					Blue						
	Define strategy						Blue					
Data and Environment exploration	Explore dataset				Purple							
	Data selection					Purple						
	Explore environment						Purple					
RL offline model	Algorithm selection											
	Network architecture											
	Reward function											
	Model training											
	Baseline											
MARL online model	Full reward function											
	Self-play setup											
	Initial training											
	Competitive self-play											
	Policy convergence											
	Finalization											
Documentation	Checkpoints			Yellow								
	Report				Yellow							
	Final presentation					Yellow						

Thank you !



Politecnico
di Torino



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DB
MG