- TEAM FAST AND SMART -

KHABAZI RESERACH CENTER, IRAN

JUNIOR SOCCER OPEN WEIGHT

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About Us :

We are Fast & Smart, a dedicated robotics team from Iran. Our team consists of three highly skilled members, each excelling in their respective fields far beyond expectations.
We proudly secured the second place in the national competitions, achieving the highest number of goals scored.
This accomplishment is incredibly valuable to our team and showcases our commitment and prowess in robotics.
Our team motto is: "Impossible is Nothing."

Abstract :

For RoboCup 2024, we had a limited timeframe to develop a new and more powerful robot compared to our previous models.
During this short period, we faced various challenges and achieved significant progress.
Our team's focus in most past and present competitions has been on coding.
The majority of our advancements are rooted in the sophisticated code we developed, aimed at maximizing the robot's physical capabilities.

We employ two programming languages: Python and C. Python is used for image processing, while C is utilized to implement motion algorithms based on calculated angles and distances.
Additionally, we worked on the robot's design and structure, enhancing its durability.

In the electronics department, we redesigned and optimized the PCB to accommodate more powerful motors and higher currents.
These improvements ensure that our robot is well-prepared to compete at the highest level in RoboCup 2024.

In this poster, we delve into the detailed components of our robot, including the robot kicker, voltage enhancement, movement system, and the mirror used in the robot, detailing its construction. We also present an exploded view of the robot, showcasing the various sections.
The most critical part of our poster focuses on our movement algorithms and the coding aspect, which are integral to our robot's performance.

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RoboCup EINDHOVEN 2024

Robot Design and Electronics

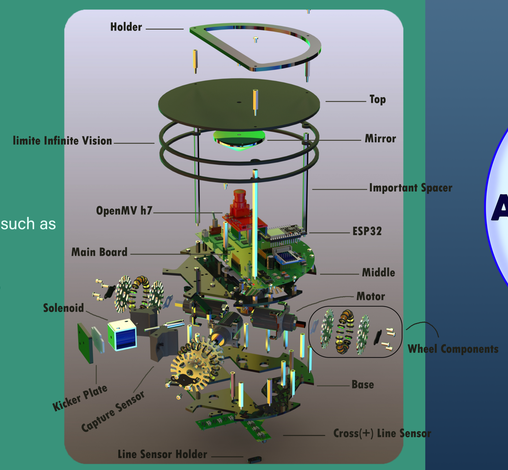
Robot Exploded View: Layered Architecture and Component Integration

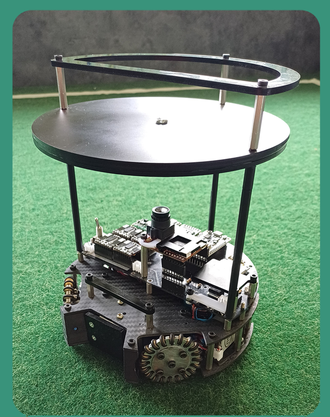
At the top of our robot,
the handle is attached.

The top layer,
which serves as the mirror holder,
is made of plexiglass and is positioned
13 cm above the middle layer.

The middle layer,
constructed from carbon fiber,
houses the main circuitry and components such as
the OpenMV, ESP32, and motor drivers.
Additionally, our motors and
kicker are mounted below this middle layer.

Beneath this is the base layer of the robot,
which contains our line sensors
and the kicker circuitry.





Our meticulously engineered robot designed for RoboCup 2024!

Main PCB :

Our main printed circuit board (PCB) integrates components tailored to meet our robot's diverse requirements. Key features include:

OpenMV H7 R2:
A high-performance image processing module running at 420 MHz clock speed, enabling real-time visual data analysis.

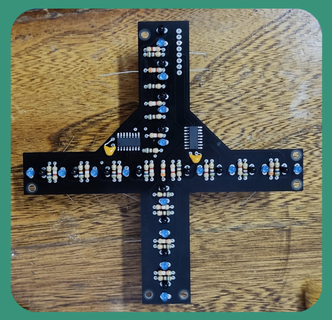
ESP32:
Operating at 240 MHz, the ESP32 serves as the central controller. Despite considering the Teensy as an alternative due to time constraints and availability issues, we opted to continue with the ESP32.

8733 Motor Drivers:
Selected for their compatibility and efficiency with our motors, ensuring reliable performance during operation.

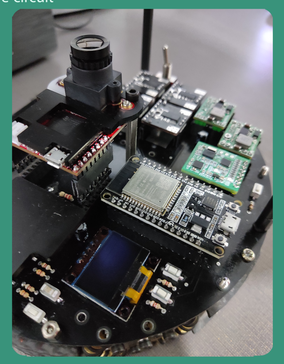
TDX1105 Gyroscope:
Used for precise orientation detection, facilitating accurate navigation and control of the robot.

DC-DC XL6009 Boost Converter:
Provides stable power supply management for the kicker system

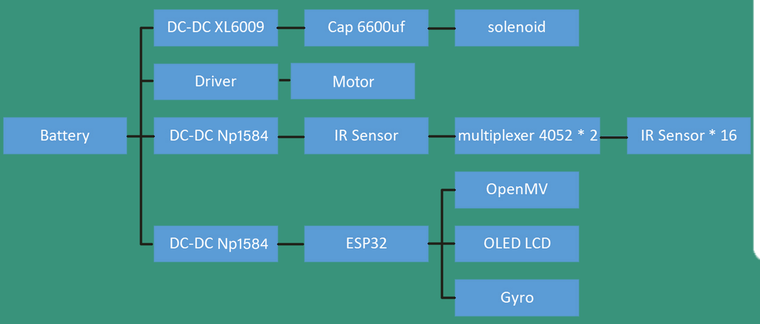
DC-DC Np584 step down converter:
Provides stable power supply management for the entire circuit



Line Sensors:
In our robotic system,
we have employed IR sensors for effective line detection,
addressing our specific needs. A total of
16 IR sensors have been integrated into the robot.
Originally, we intended to use an array of 32 sensors,
but due to time constraints, we modified
the sensor layout from a circular arrangement to
a plus-shaped configuration.
This adjustment allows us to experiment
with different motion algorithms compared to those tested
with a circular layout.



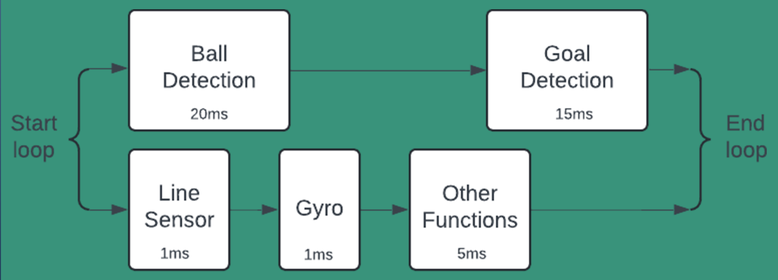
This diagram provides a visual representation of
how each part works



Programming and Movement algorithm

Programming and Time Management :

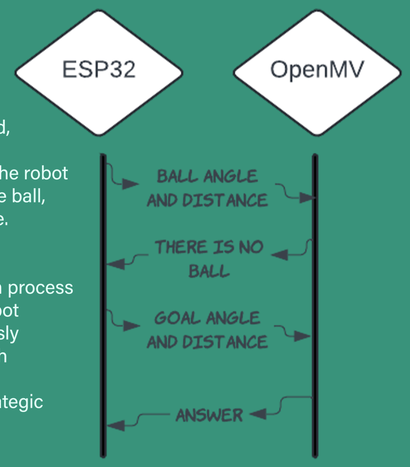
The most critical factor in the speed and reaction of our robot towards the ball and the goal is the efficient management of function execution time. You can observe the time management strategy of our team in the timing diagram below.

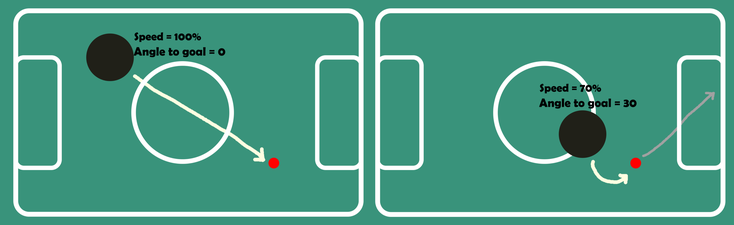


In our robot, the OpenMV and ESP32 communicate through a serial port,
with the ESP32 acting as the master and the OpenMV as the slave. At the start of the program,
the ESP32 requests the angle and distance from the OpenMV.
If the OpenMV responds with a value of 400, it indicates that no ball is detected on the field.
Consequently, the ESP32 requests the angle and distance to the goal,
and the OpenMV provides this information, enabling the robot to return to its initial position,
regardless of its current location on the field.

Robot Movement and Speed Adjustment:

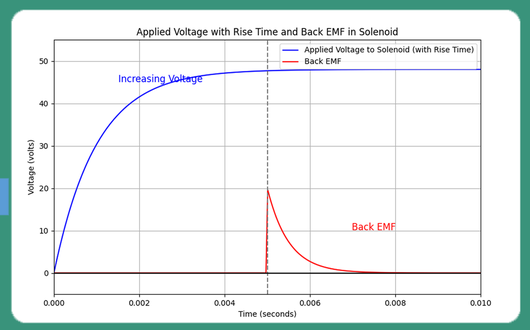
Once the distance to the ball is determined,
we dynamically adjust the robot's speed
based on this distance. This ensures that the robot
can efficiently and accurately approach the ball,
optimizing its movement and reaction time.
As the robot gets closer to the ball,
it begins to orient itself towards
the goal for a precise shot. This orientation process
is crucial for accurately positioning the robot
to kick the ball into the goal. By continuously
monitoring the distance and adjusting both
its speed and direction, the robot can
effectively navigate the field and make strategic
decisions to score goals.

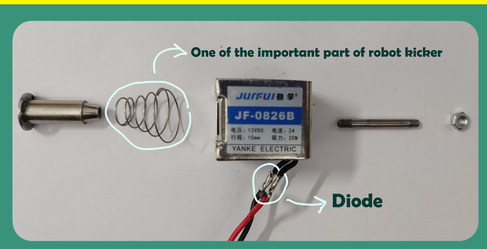




Kicker System :

we use this solenoid in our robot
our kicker mechanism features a solenoid powered by 46 to 48 volts,
delivering a substantial impact to the ball. Key considerations in
this section include the rear spring behind the solenoid and
the protective diode.It's worth noting that our team
utilizes a single kicker in each robot.





Back Spring:
Based on our experience, we discovered that tightening
the spring behind the solenoid increased the kicking power contrary to
our initial expectations. When voltage is applied to the solenoid,
the spring resists the initial motion, causing a gradual increase in
the solenoid's voltage until it matches the applied voltage.
A stronger spring compresses more energy,
resulting in a more instantaneous and
powerful release when the solenoid is activated.

Protective Diode:
To safeguard the electronic components from voltage spikes generated
during solenoid operation, we utilize a 1N1007 diode. This diode prevents
the back EMF from damaging the main circuitry. The key aspect here is
the diode placement. While some teams place this crucial diode on the main circuit board,
which can introduce noise into the primary circuitry, we have positioned
the diode as close as possible to the solenoid. This placement ensures that
the back EMF is redirected to the solenoid immediately,
preventing noise from affecting the main circuit.

Motors :

In the past, we utilized Maxon motors for our robot.
However, these motors did not provide
the necessary torque for our future competitions.
Consequently, we switched to Chinese JMP motors,
which offer significantly higher torque
and a more affordable price.
The JMP motors we now use provide a
torque of 20kg. While it is true that
these motors may not match
the precision of Maxon motors,
we can compensate for this with
optimized coding to correct
any inaccuracies. This upgrade ensures
that our robot has the necessary
power and reliability to perform effectively in
competitive environments.