jHockey Tracking & Communications Setup

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EN 530.421 Mechatronics

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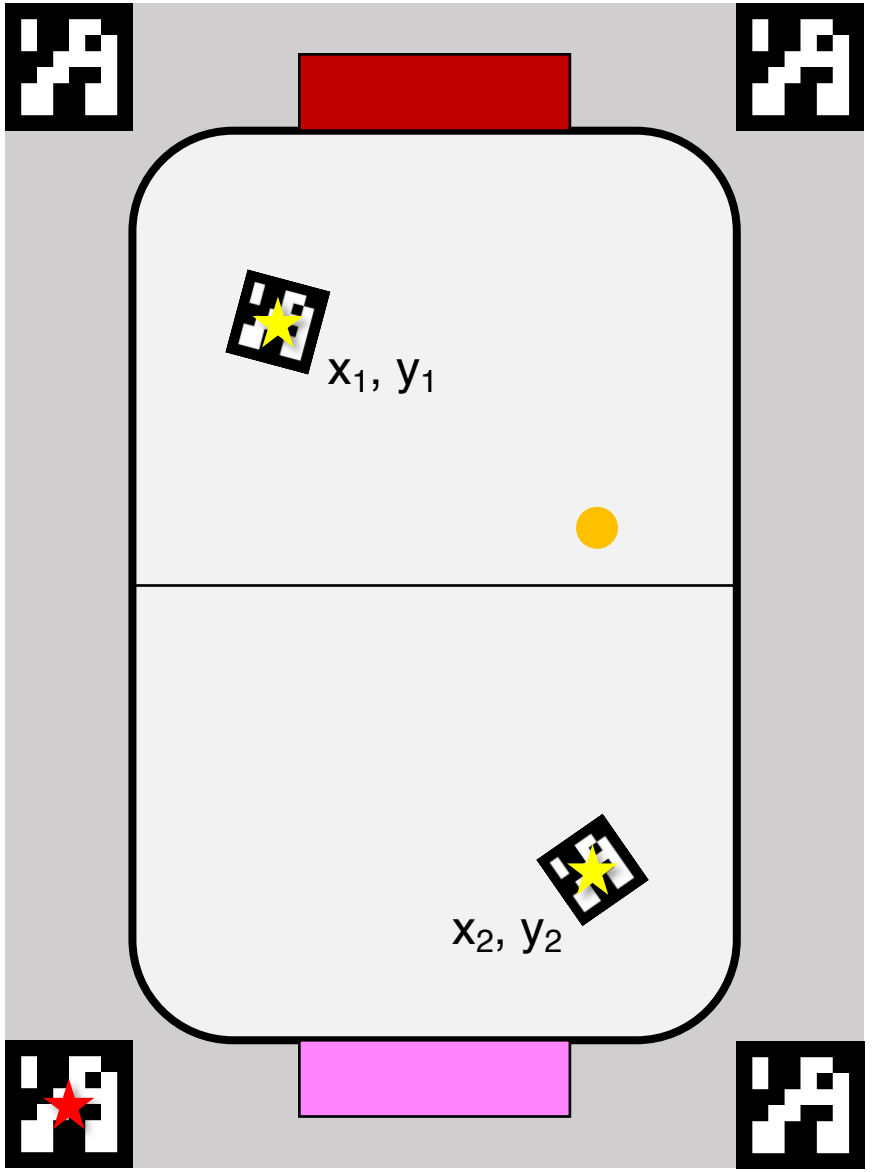
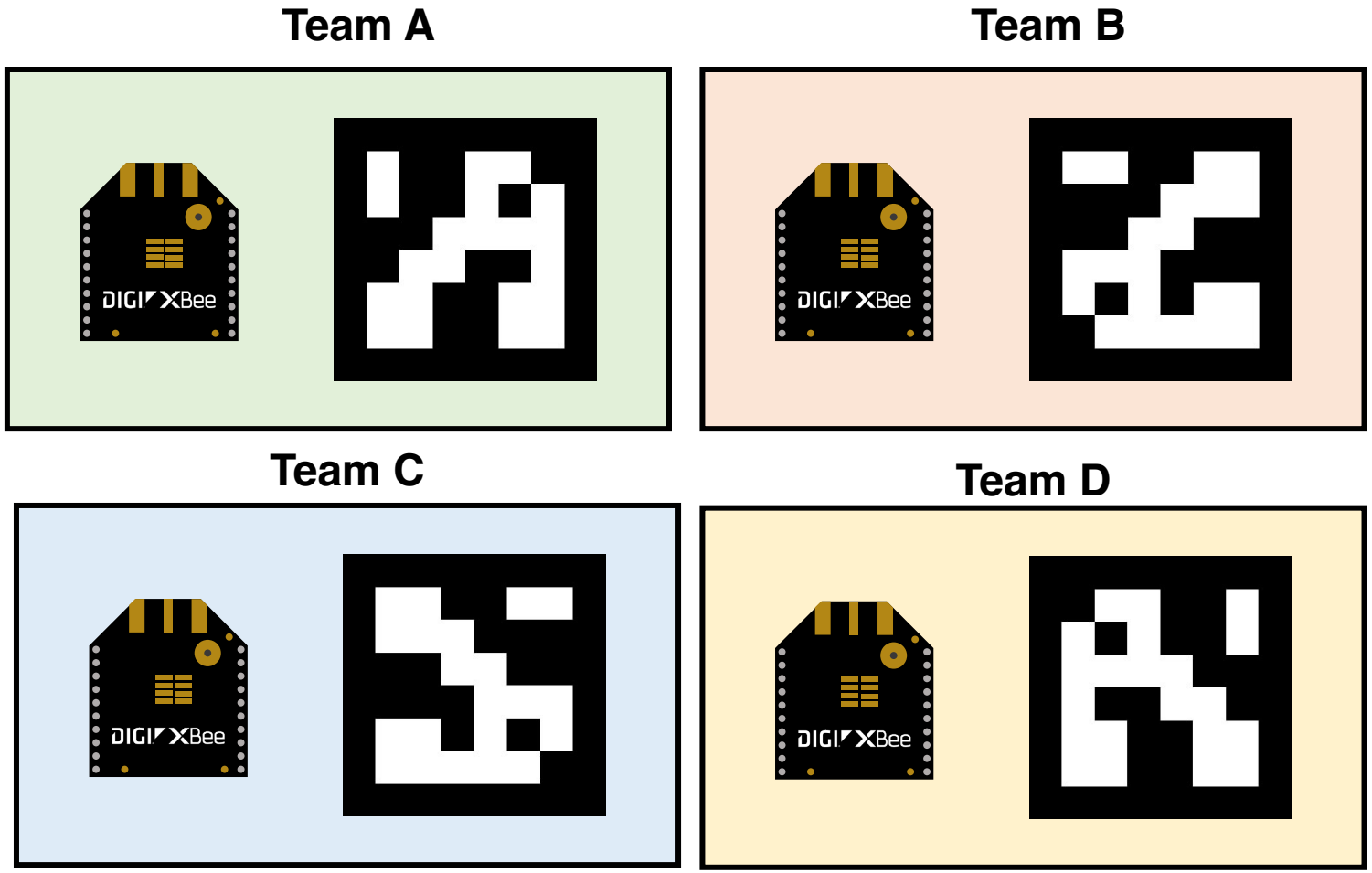
Robot Tracking

- You will need your position on the arena to move around and score goals.
- We have made a tracking system for you, using a **computer vision algorithm deployed on a camera to track ArUco tags** on *top* of your bots.
- The camera talks to a Raspberry Pi, which in turns relays information to your bot via a **ZigBee protocol.**



Robot Tracking

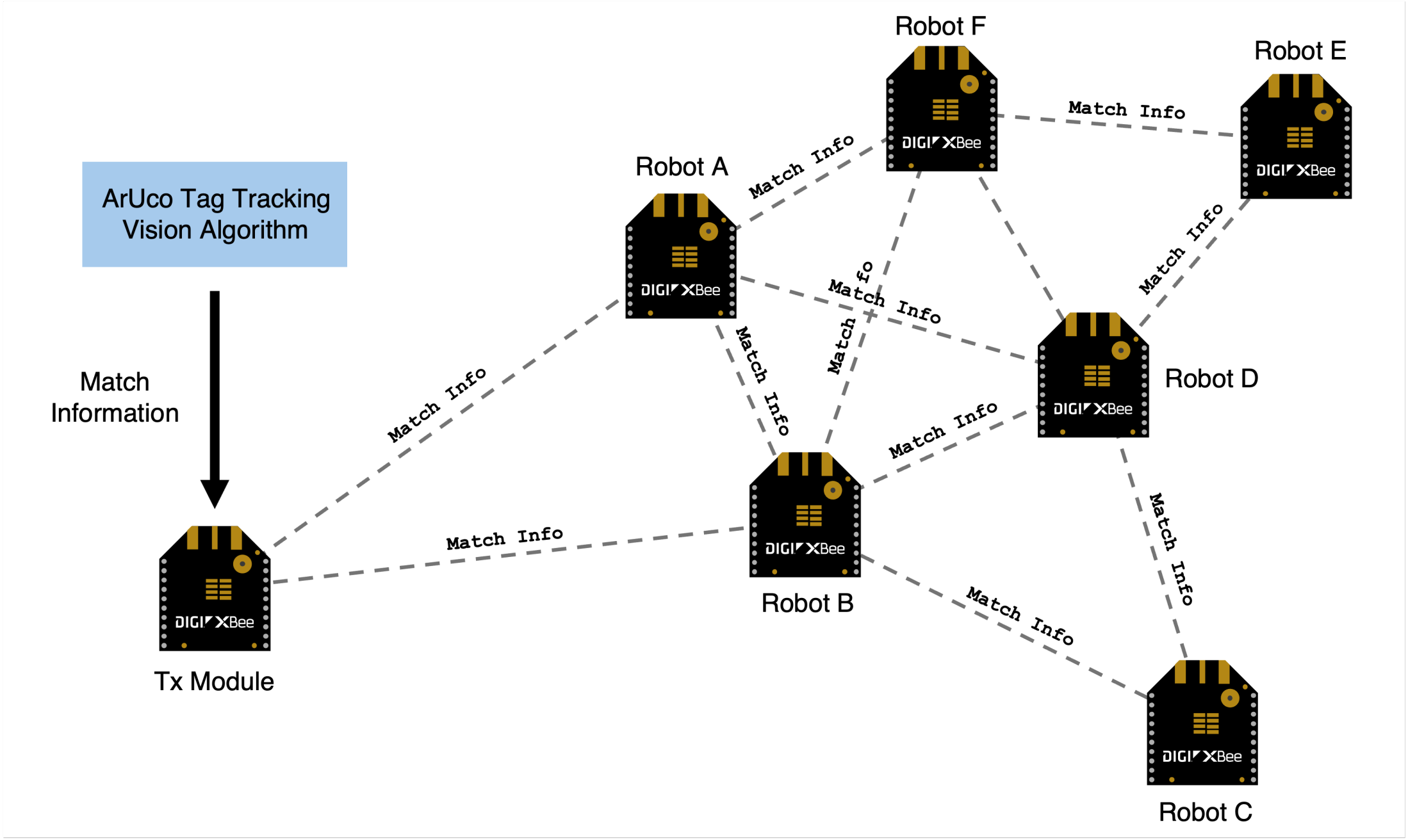
- Each team will have a **paired set of ArUco and ZigBee tags.**
- *Make sure they are labelled and stay paired!*



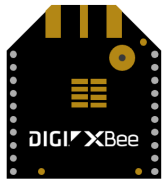
ZigBee: Communicating the Coordinates

- *"ZigBee is a high-level communication protocol used to create personal area networks with small, low-power digital radios."*
- **Similar to WiFi and Bluetooth** radios but has some strengths and weaknesses.
- Suitable for applications where **power consumption** is a critical factor, such as in wireless sensor networks and home automation devices – and our bots!
- Operates on the IEEE 802.15.4 specification and is designed to provide **secure and reliable** wireless data transmission at low data rates.

- **Device Types** (Based on Functionality):
  - ***Coordinator Node:*** Root of a network tree, usually one per network.
  - ***Router Node:*** Can join existing networks and send, receive, and route information.
  - ***End Node:*** Device capable of talking to the network, cannot act as messenger between any other devices.


ArUco Tag Tracking Vision Algorithm
Match Information
Tx Module
Robot A
Robot B
Robot C
Robot D
Robot E
Robot F
Match Info
Match Info
Match Info
Match Info
Match Info
Match Info
Match Info
Match Info
Match Info
Match Info
Match Info
DIGI XBee

ArUco Tag Tracking CV Algorithm → Tx



Tx XBee Module

Sends the information as a string, which looks like:

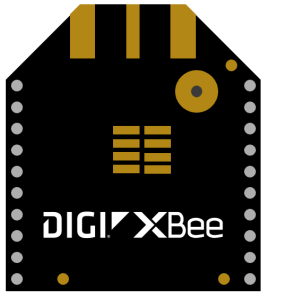
`>14528A234354E454323G895324M455829CC;`

Match Time Bot A Bot E Bot G Bot M Checksum

- The string can have up to 114 bytes (characters).
- Polls the information at ~20Hz.

Bot's XBee Module

- Has a bot ID programmed into it.
- Stores only the latest string received.
- Runs a Micropython script to parse the string.
- Returns only the assigned bot ID's information.



Module ID "G"

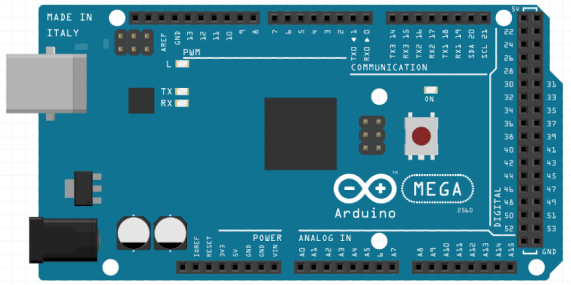
?

Query

Response

`1,4528,895,324`

Match Byte — Game Time — X — Y



Arduino Mega

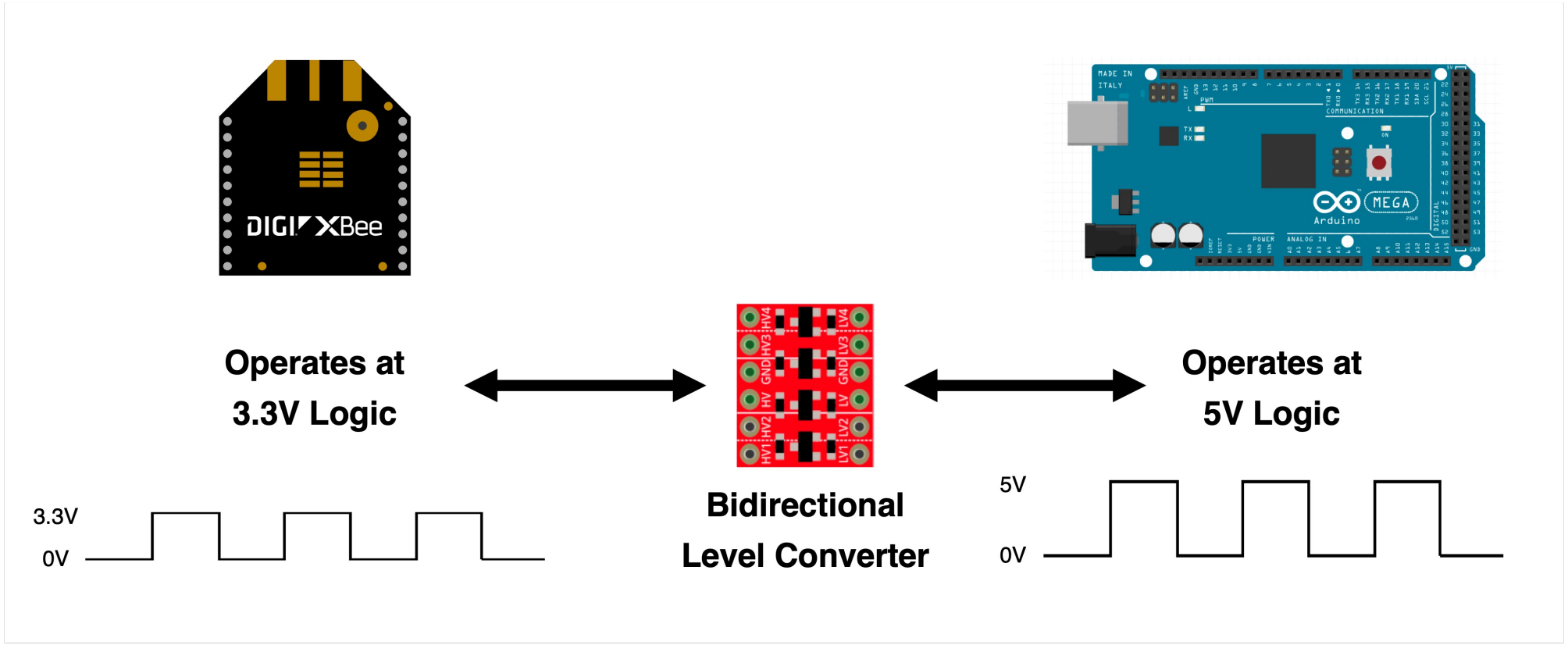
- Sends a query containing "?" to the XBee Module via UART.
- Receives the latest coordinates via UART.

Expected Outputs

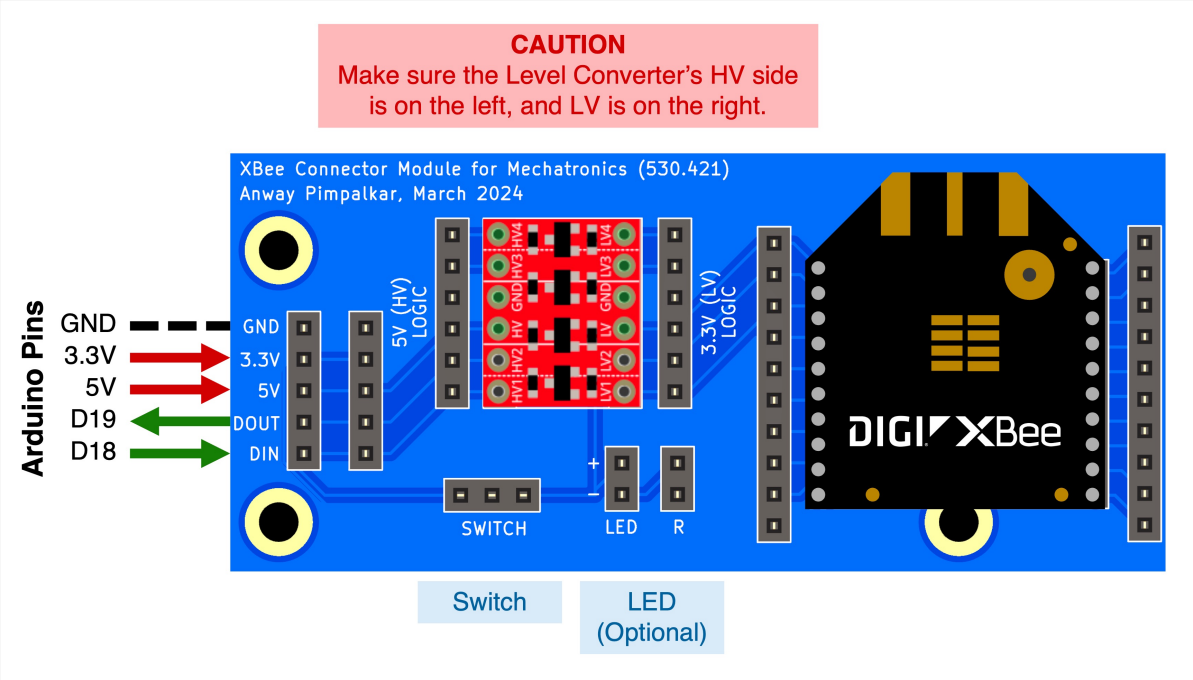
- The tracking system relays information specific only to your robot. *(i.e. you will not have access to your opponent's location).*
- Send a `?` to the XBee to receive your tracking information.
- You can expect 4 different types of outputs from your XBee module:
  - `M,TTTT,XXX,YYY` Ideal output.
  - `M,TTTT,---,---` If your bot's information is not sent across by the Tx (camera has not detected it).
  - `?,????,---,---` If the XBee module is not receiving any information from the Tx for more than 1 second.
  - `/,////,---,---` If the checksums are not matching.
- *If your bot runs into a parsing error, it will also be printed into the serial.*

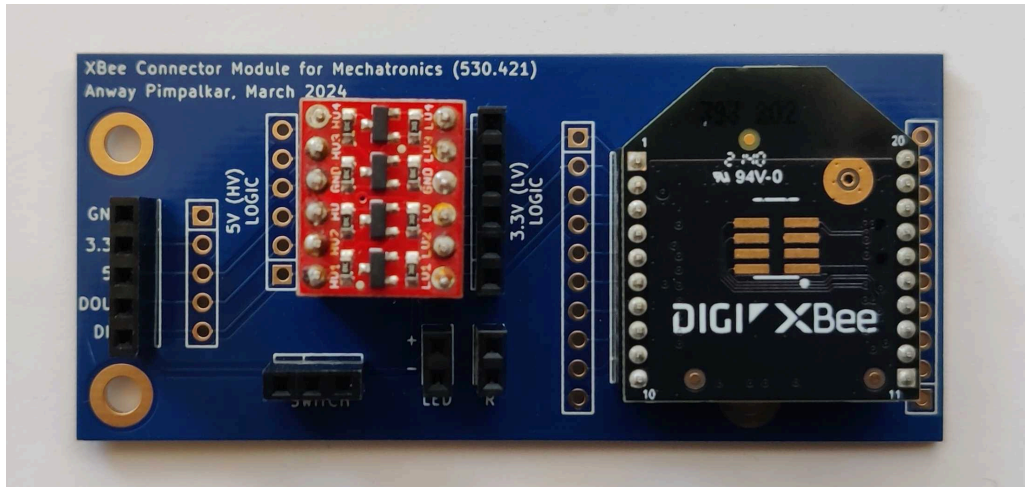
Interfacing XBee with your Bot

- You can communicate with the ZigBee modules over UART, but..



Interfacing XBee with your Bot





Sample codes and CAD files will also be made available.

Some Tips

- You receive the coordinates of the center of your tag – make your robot accordingly!
- The information is relayed at approximately ~20Hz, with ~70ms latency.
- Up to 15 robots can be tracked at once.
- Do not cover the four ArUco tags in the corners, and make sure no one else is covering them either!
- Sometimes the tracking system may not detect your bot intermittently – you can come up with contingencies!
- If you want, you can also think of smart ways to detect your opponent's position.

An accurate bot is much better than a fast bot!