**Detailed Workflow for Doosan Cobot**

**1. Objective**

The Doosan Cobot A's task is to recognize parts of a hammer (square or rectangular) using a vision system and accurately place them on a tool plate on the Omron AMR.

**2. Process Workflow**

1. **Part Recognition**:
   * The Doosan Cobot A uses a **Coral Dev Board** vision system to analyze incoming hammer parts.
   * It identifies whether the part is square or rectangular based on predefined parameters (size, shape, edges).
   * The recognition result is used to determine the proper placement orientation.
2. **Picking**:
   * The cobot moves to the pickup location, guided by the recognition system.
   * Using its gripper, it carefully picks the identified part.
3. **Placement**:
   * The cobot moves to the tool plate on the Omron AMR.
   * Depending on the part type (square or rectangular), it places the part in the designated position.
   * Ensures parts are aligned correctly to avoid interference during transport.
4. **Communication with AMR**:
   * The cobot sends a signal (via I/O or Ethernet/IP) to the AMR to indicate that the placement task is complete.
   * Awaits confirmation from the AMR before starting the next cycle.

**3. Components Involved**

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| **Components** | **Function** |
| Doosan Cobot A | Equipped with a multi-functional gripper and precise motion control. |
| Coral Dev Board | Provides image processing capabilities for part recognition. |
| Tool Plate on AMR | Customized for securely holding square and rectangular parts. |
| I/O Module or Communication Protocol | Facilitates signalling between the cobot and the AMR. |

**4. Inputs and Outputs**

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| **Inputs** | **Outputs** |
| Input 1: Vision system data (image of the part). | Output 1: Placement position and orientation for the gripper. |
| Input 2: Signal from AMR (ready for part placement). | Output 2: Signal to AMR (placement task completed). |

**5. Key Functional Requirements**

* The vision system must achieve a recognition accuracy of at least **95%** for part identification.
* The cobot's placement tolerance must be within **±1 mm** to ensure stability during AMR transport.
* The process cycle time (recognition, pick, and place) should not exceed **15 seconds** per part.

**6. Safety Measures**

* Equipped with collision detection to ensure safe operation near humans and other equipment.
* Gripper equipped with a soft-touch mechanism to avoid damaging parts.
* Emergency stop button accessible for manual override.

**7. Risks and Mitigation**

* **Risk**: Misidentification of parts due to poor lighting or image quality.
  + **Mitigation**: Calibrate the vision system and ensure consistent lighting conditions.
* **Risk**: Improper placement on the tool plate, causing instability.
  + **Mitigation**: Program double-check alignment after placement.