# KBBQ for KBBeginners

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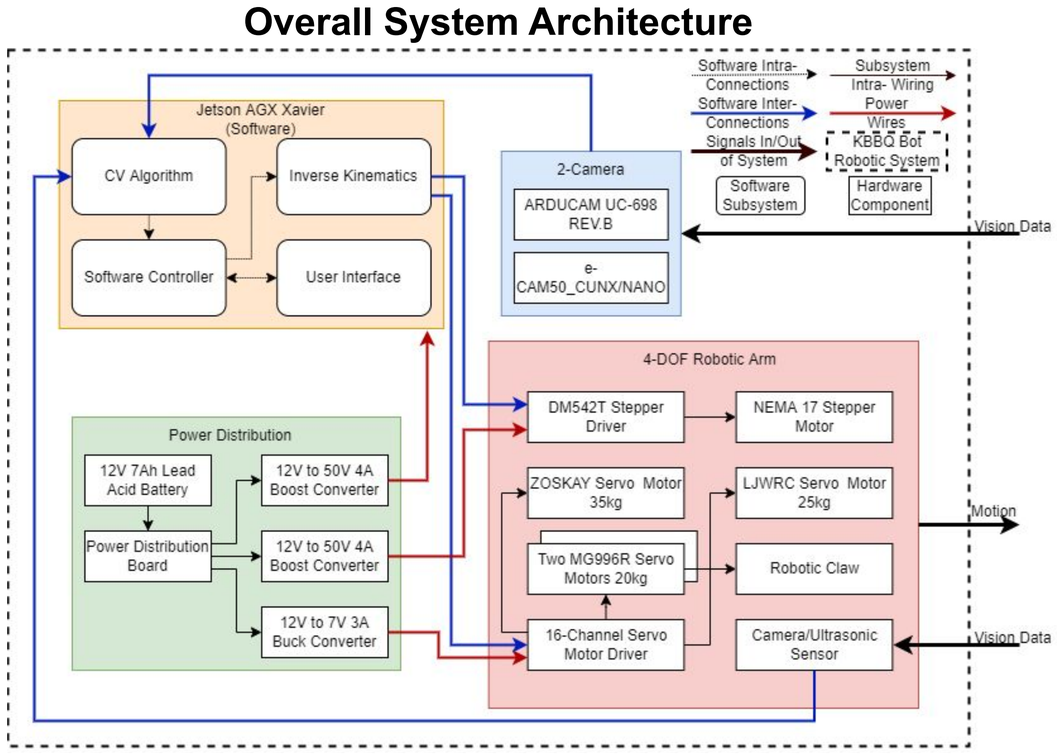
## Product Pitch

Korean food is growing in popularity, and Korean barbeque (KBBQ) is delicious cuisine, but can be slightly daunting to people who have never experienced it before. To aid beginners through this, we implemented a robotics system that can help KBBQ beginners to properly cook meats. The system uses computer vision and a robotic arm to scan various meats and automatically cook them, leading to food that is cooked well every time. Our robotic arm must be able to reach dishes and all areas of our 13.5 cm by 13.5 cm grill. It should also be able to function for at least 20 minutes, and at most 45 minutes. We want our meat cooked "just right" 70% of the time and not be undercooked or burnt meat.

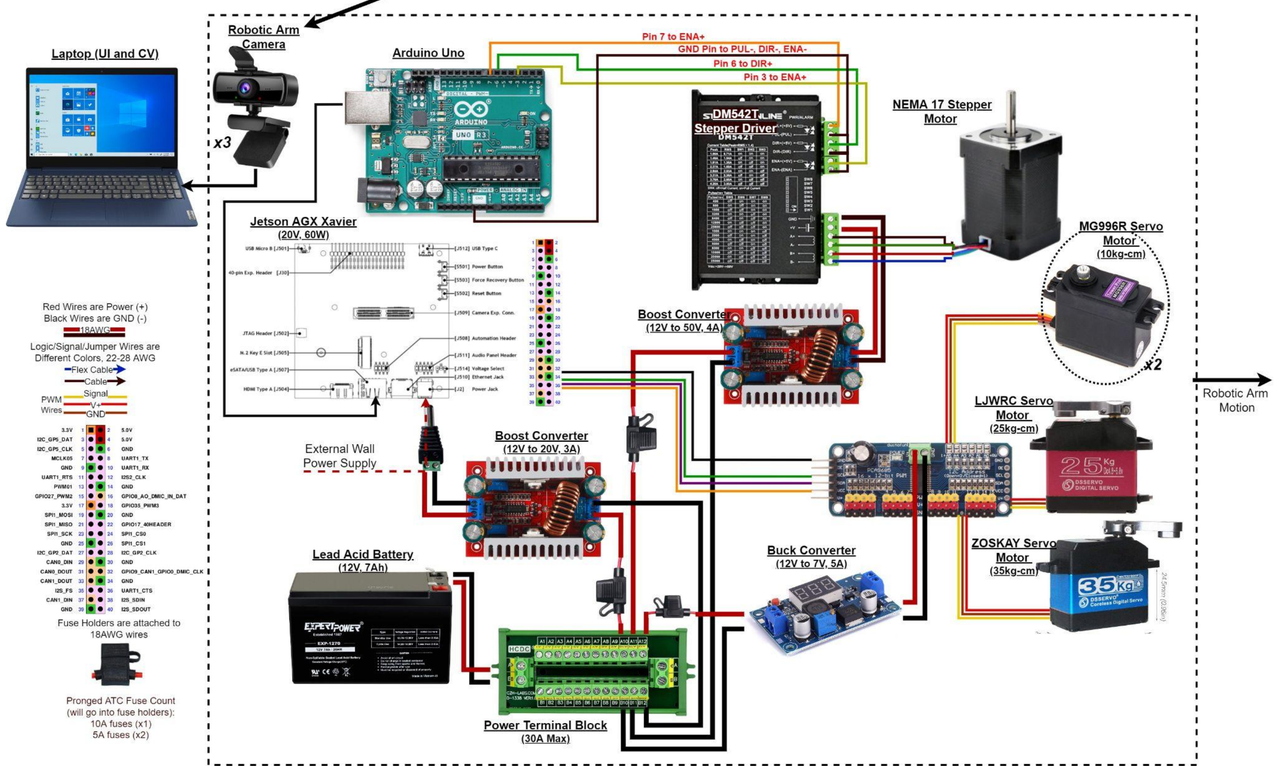
## System Architecture

The KBBQ robotic system will have four main subsystems: the Robotic Arm, Computer Vision, User Interface, and the Software Controller.

### Overall System Architecture

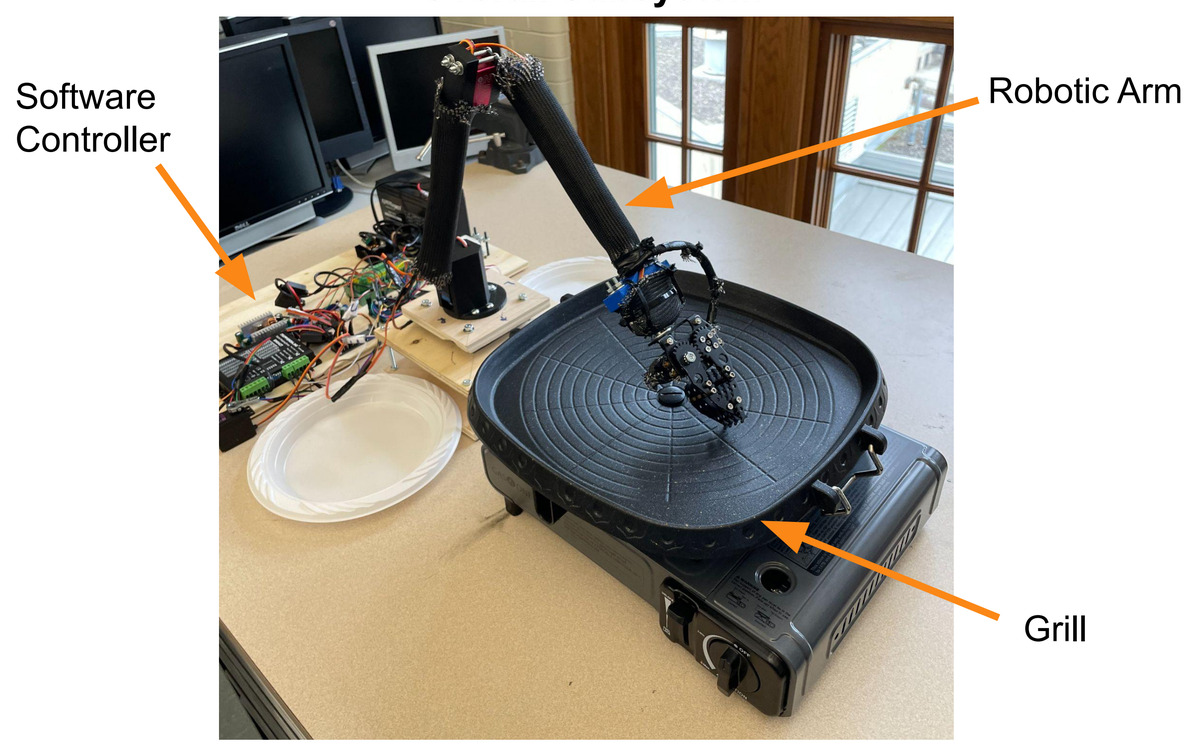



### Robotic Arm Implementation




## System Description

### Overall Subsystem




### UI Interface


## System Evaluation

| Feature | Testing Method | Output | Accuracy | Results |
|---|---|---|---|---|
| Meat type recognition | Placing plates of food in front of camera | Algorithm item guess | Under 5 seconds 80%+ Accuracy | .05 Seconds 76% Accuracy |
| Thickness Recognition | Holding cuts of meat in front of camera | Thickness estimate | ±1/16 in | ±1/10 in |
| Robotic Arm Movement Error | See if Robotic arm can touch a predetermined point | Amount of Movement Error in kinematic software | ±1/16 in | ±1/4 in |
| Cooking Time Algorithm | Manually see if the amount of time calculated properly cooks given meat | Cooking time estimate | Meat fully cooked, but not burnt Internal temp of 145F pork, 170F beef min | TBD |

### CV Results

| | | Actual | | | | |
|---|---|---|---|---|---|---|
| | | Slab | Blob | Round | None | Pred Total |
| Predicted | Slab | 13 | | 2 | | 15 |
| | Blob | 2 | 6 | | | 8 |
| | Round | 2 | 1 | 9 | | 12 |
| | Miss | 1 | | 1 | 2 | 4 |
| | Total Actuals | 18 | 7 | 12 | 2 | |

## Conclusions & Additional Information

In the process of implementing our design, we ran into some challenges. Having Inverse Kinematics for the robot arm and blob detection for our CV that are precise enough to fulfill our design requirements was not easy; however, in the future with more testing, we are confident that we will be able to find ways to make them function at a satisfactory level. Despite these challenges, though, we know that with more work, we can produce an effective system that will help anyone who would like a more stress-free experience with KBBQ.

Along the way, we learned that allocating more time to integrating all of our subsystems and communication are necessary because it was more difficult and time consuming than we initially expected.

https://course.ece.cmu.edu/~ece500/projects/s22-teamb5/

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