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Dept. Of Computer Engineering

ADVANCED ROBOTIC ARM

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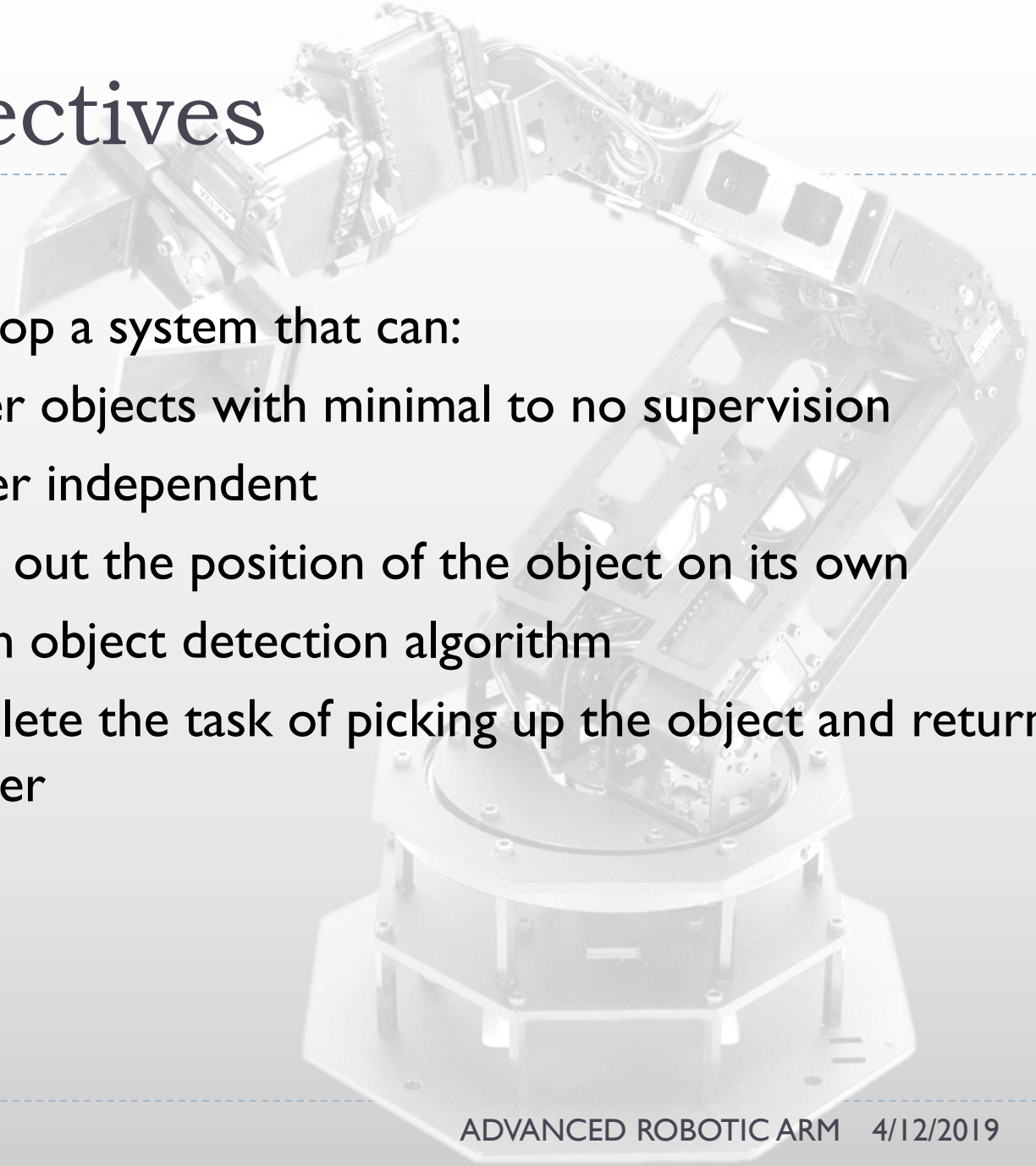
I. INTRODUCTION

- For people suffering from upper body movement disorders:
  - Amyotrophic lateral sclerosis (ALS)
  - Parkinson's disease
  - Progressive muscular atrophy (PMA)
  - Other motor neuron diseases
- Enhances the manipulation capabilities
- More independent
- Pick up objects from a table or a shelf effortlessly
- Utilizes remote controlled interface

Objectives



To develop a system that can:

- Deliver objects with minimal to no supervision
- Be user independent
- Figure out the position of the object on its own
- Use an object detection algorithm
- Complete the task of picking up the object and returning it to the user

II. SYSTEM DESCRIPTION

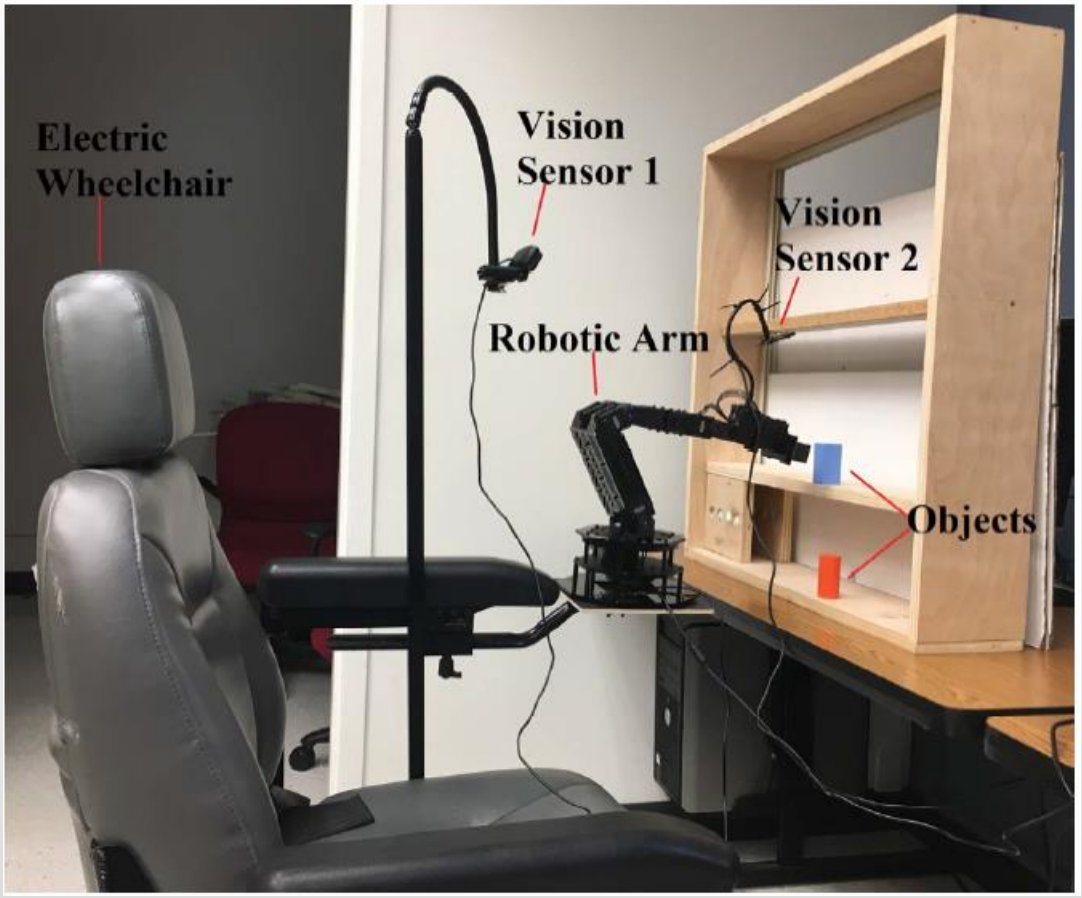


Figure 1. Image of the robotic arm mounted on an electric wheelchair

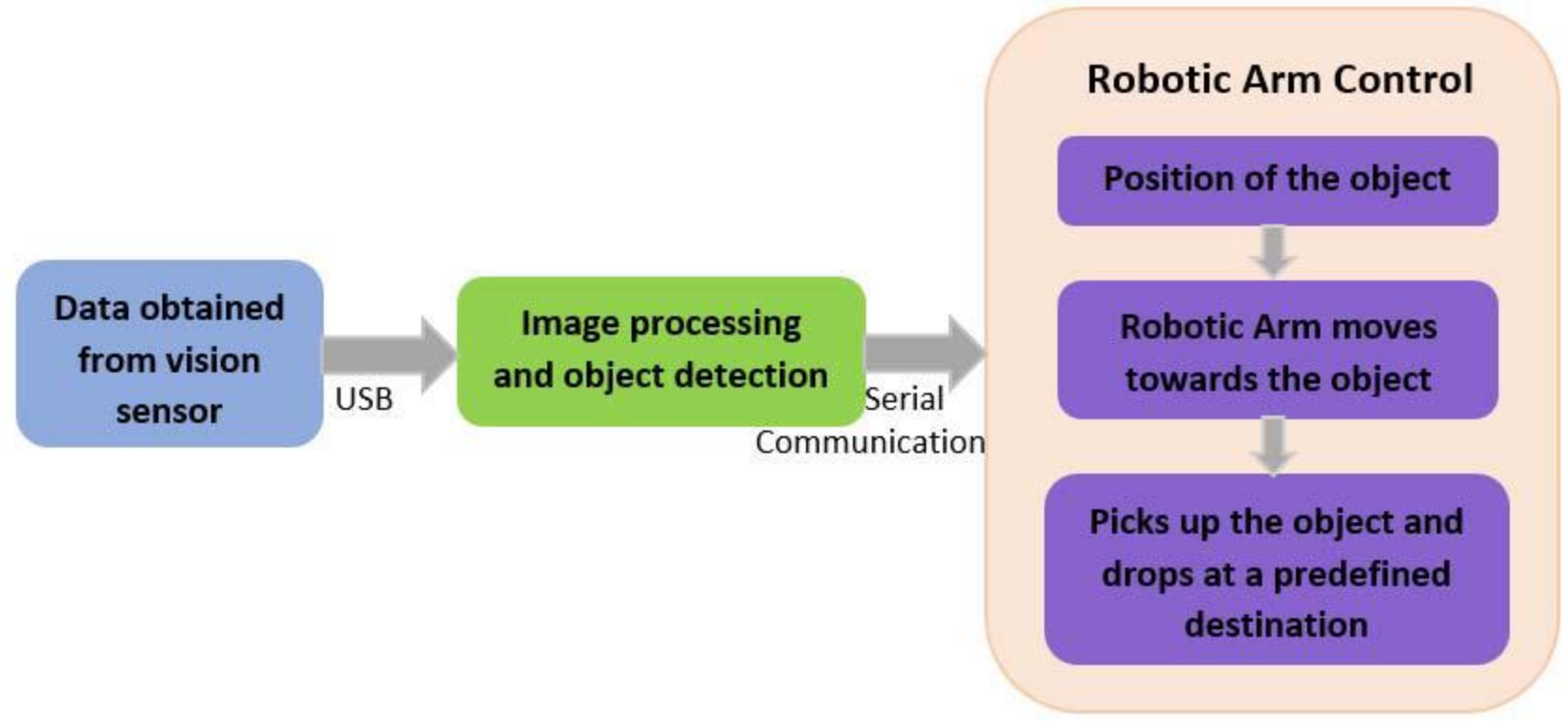
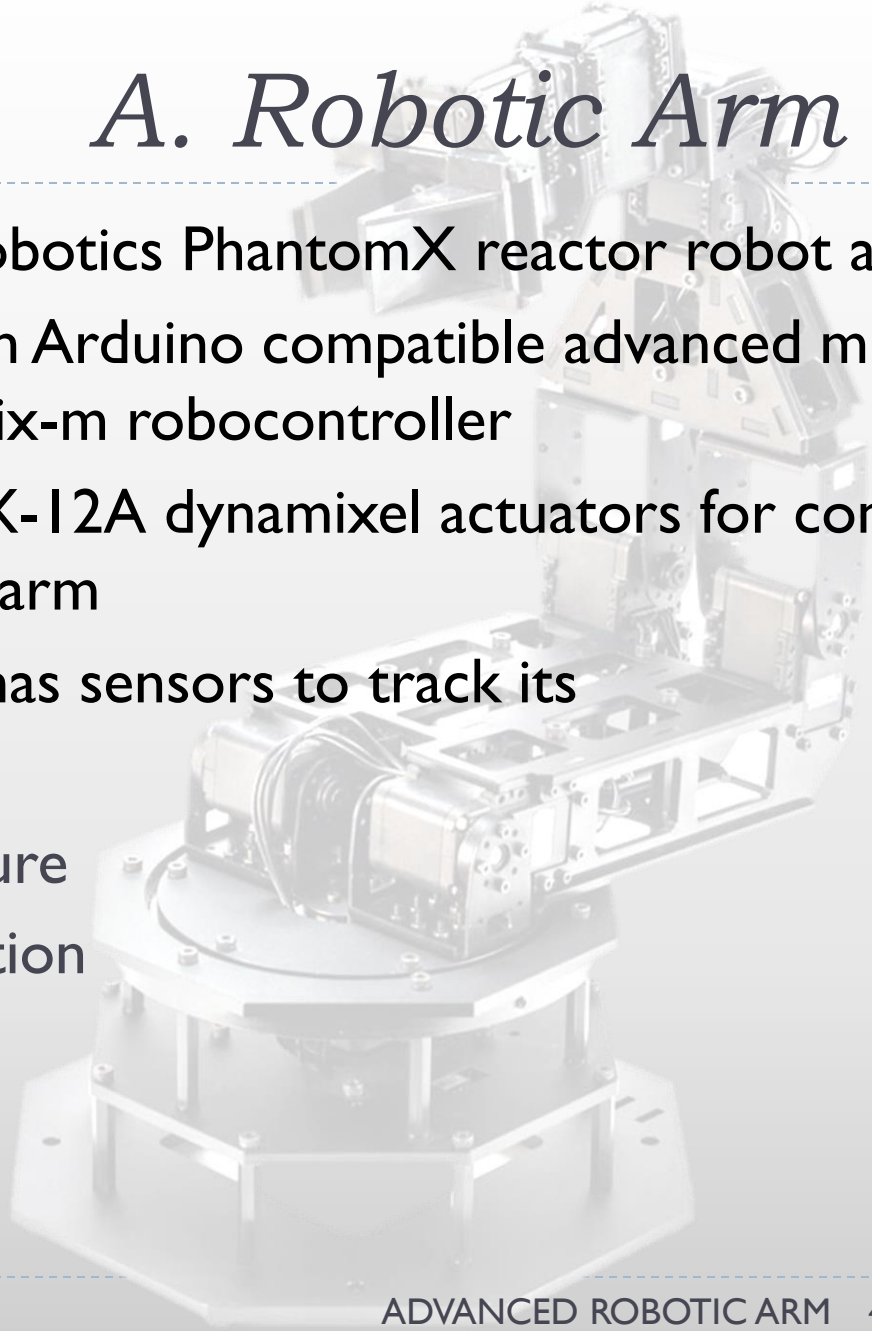


Fig 2. Block diagram of the system

A. Robotic Arm

- A Trossen robotics PhantomX reactor robot arm
- Built using an Arduino compatible advanced microcontroller called Arbotix-m robocontroller
- Has eight AX-12A dynamixel actuators for controlling different parts of the arm
- Each servo has sensors to track its
  - Speed
  - Temperature
  - Shaft position
  - Voltage
  - Load



Robotic Arm (cont…)

Servo No	Position	Axis along Degrees of freedom
1	Bottom	Horizontal(Left-Right)
2, 3	Shoulder	Backward- Forward
4, 5	Elbow	Vertical(Up- Down)
6, 7	Wrist angle	Rotation
8	Gripper	Hold/ Release

Communication of Arm and Processor

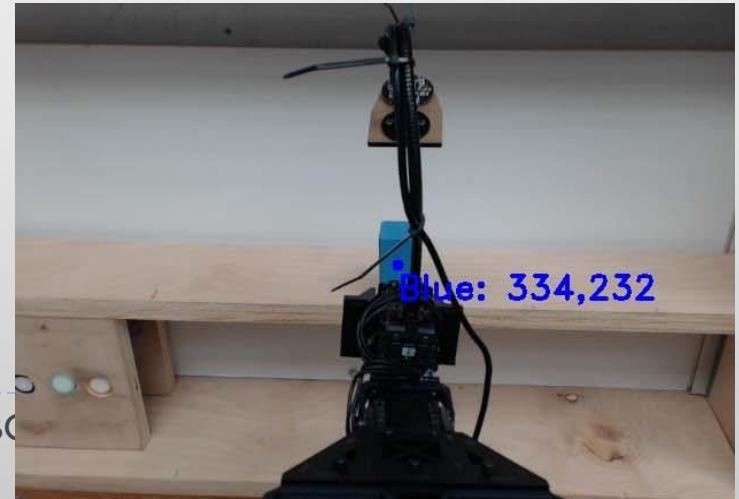
- The arm is powered by a 12V 5amp power supply
- Serial connection to a computer system via a FTDI cable
- Uses **PySerial**
- The serial connection has a baud rate of 38400
- The data packet of length 17-byte
- Each of the servo motor can be controlled by varying the 17-byte data sent to the arm
- A short delay is introduced after every serial write command

B. Vision Sensors

Vision sensor 1: Logitech HD c920 webcam

- Static
- Mounted facing the shelf located in front of the arm
- Captures the video of the arm and the shelf in real time
- Frames extracted from this video are processed
- Calculates position (x, y) of the target object
- This data is used for coarse positioning of the robotic arm

Fig 5:



B. Vision Sensors (cont…)

Vision sensor 2: robot VGA webcam

- Dynamic
- Follows vision sensor 1
- Mounted above the gripper using a 200 mm gooseneck
- Fine tunes the position of the arm's gripper before it can pick the object
- Captures a close-up video of the target object
- Used to position the gripper exactly in front of the object

so that the object can be picked up correctly

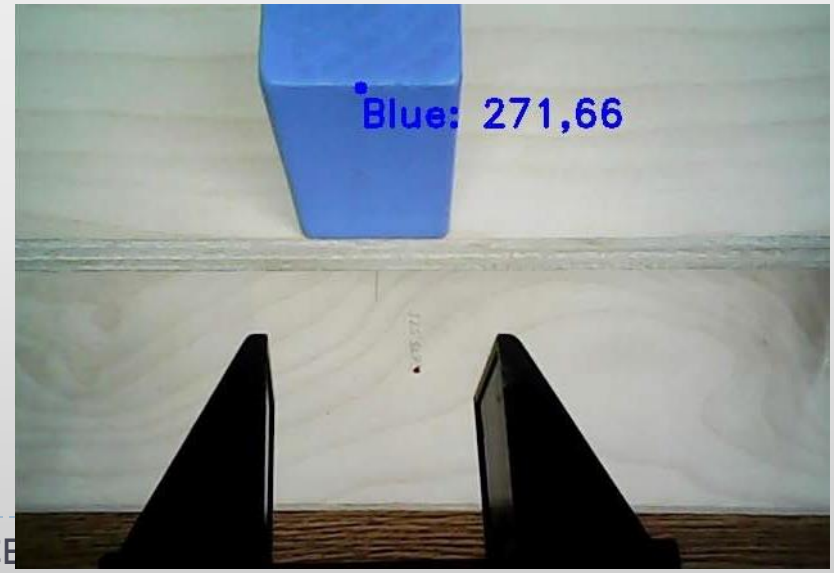
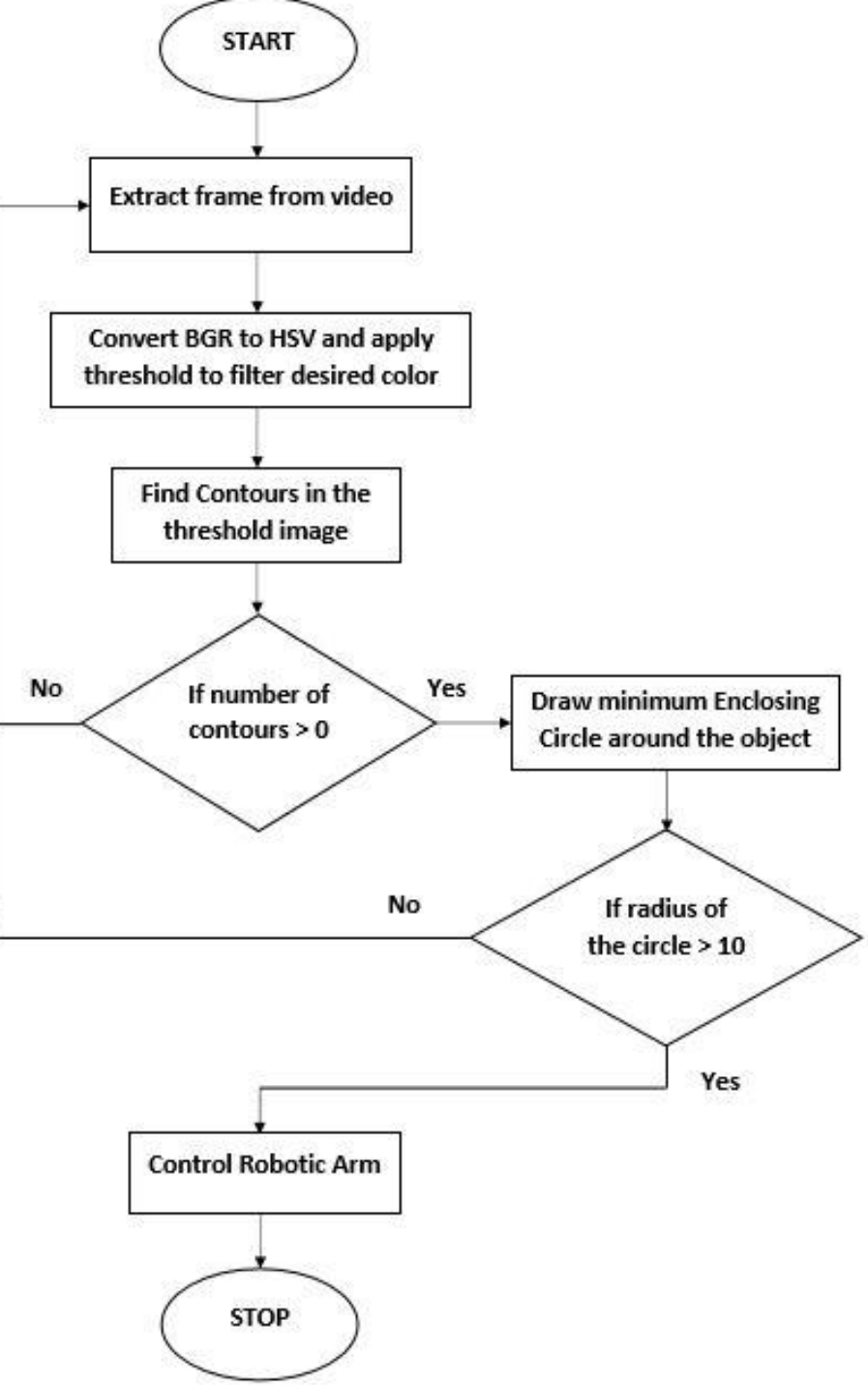


Fig 6



C. Computer Vision Algorithm

- Programmed to move towards the position of a specific colored object
- The color detection algorithm is written in python using the OpenCV library
- The vision sensor captures the real time video of the robotic arm and the object

Working of Robotic Arm

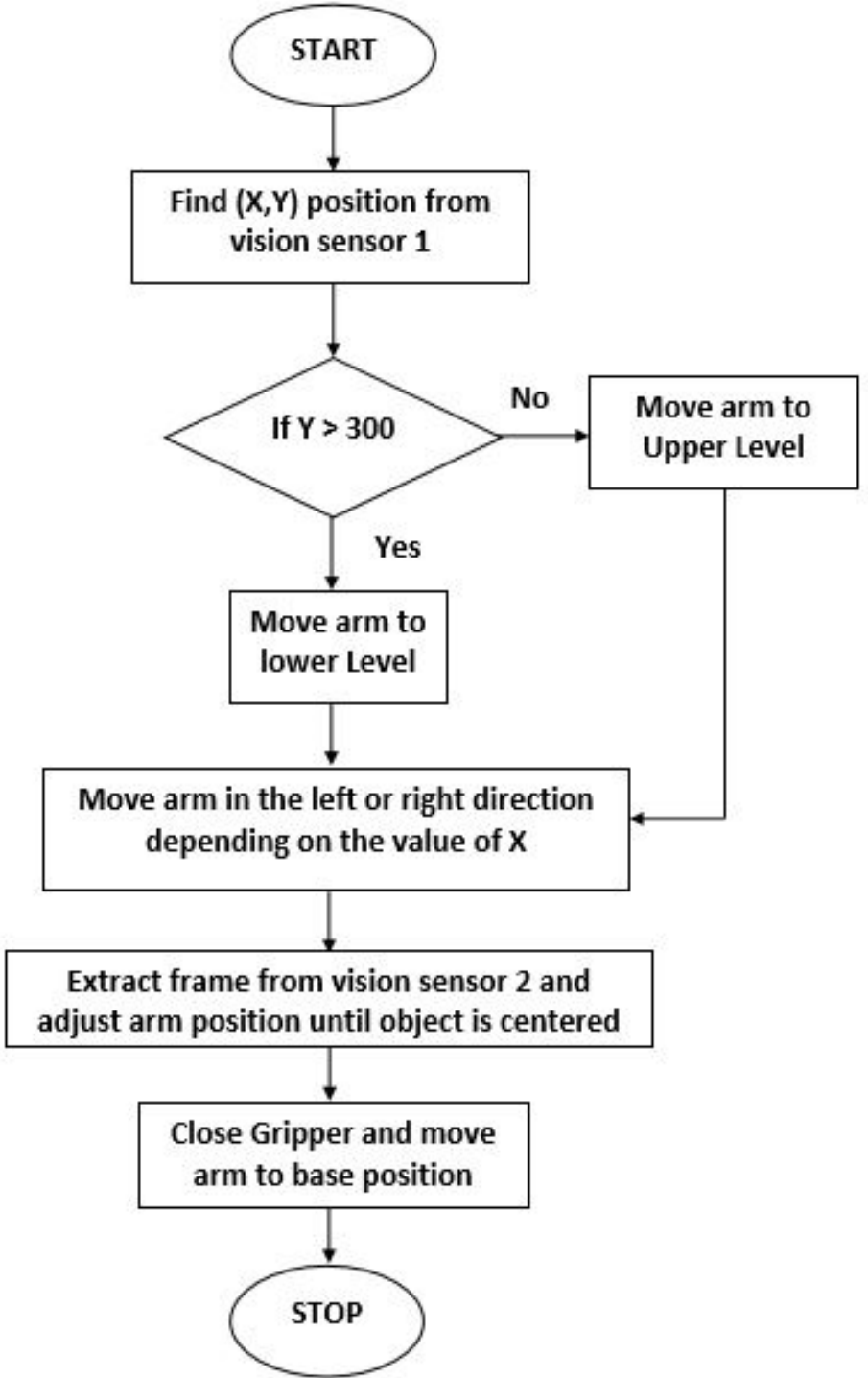


Figure 3. Flowchart for robotic arm control:

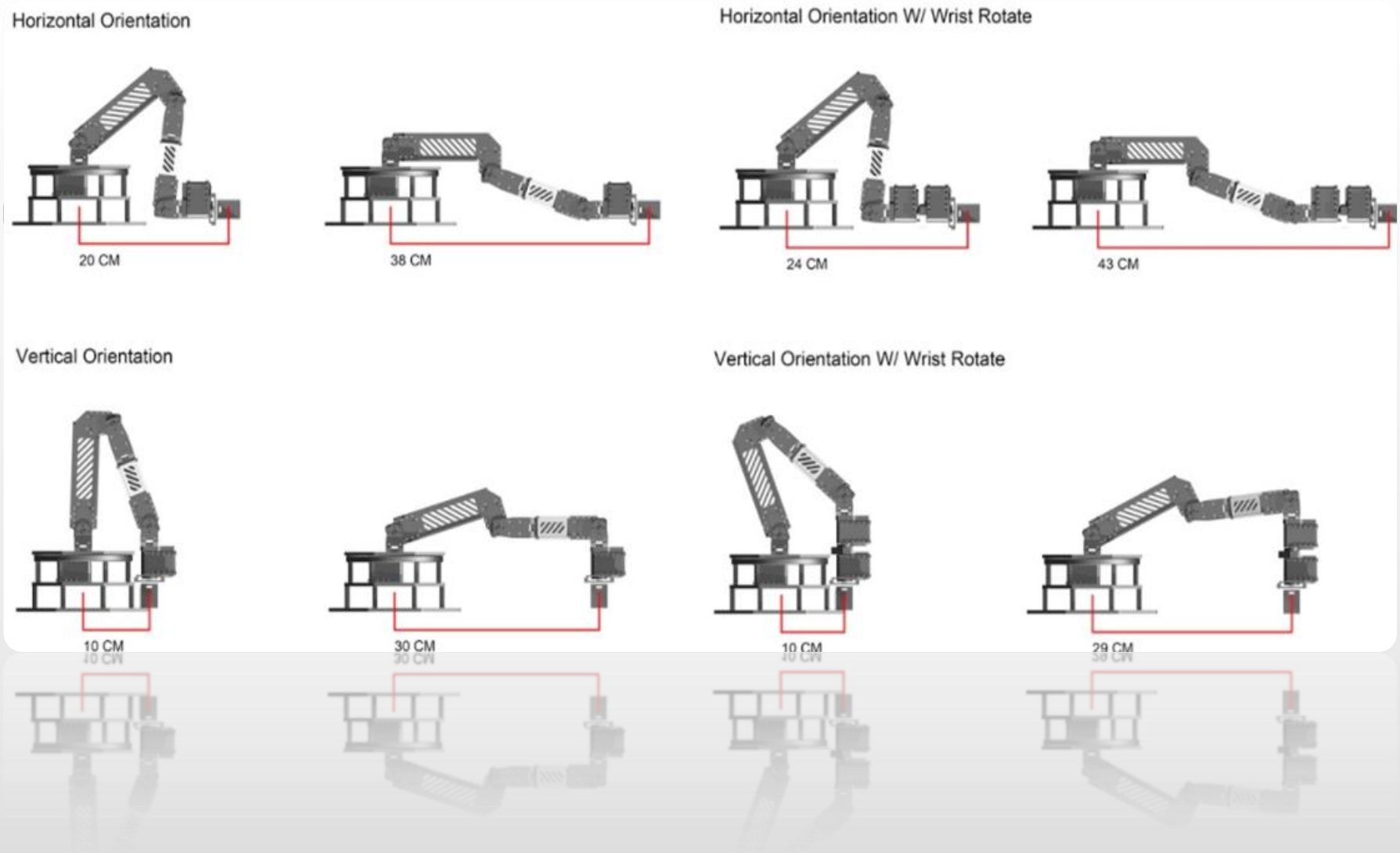


Fig 4: Range of Operation at Various Positions

IV. Advantages

- Cost- effective
- Faster
- Puts less strain on user
- Decreases dependency
- Success rate of 83.33%
- Completion of task achieved in 37.52 seconds on average

V. Disadvantages

- Attempts are more successful when the objects are placed at the upper level compared to the lower level
- Position of the detected object keeps fluctuating due to insufficient light
- Working depends mostly on the amount of light percieved from the object

VI. CONCLUSION

- Computer vision algorithm based on colour detection has been developed
- Two sensors were used:
  - First sensor- to obtain the coarse location of the object
  - Second sensor- for fine localization
- Ability to pick up objects placed at different locations on success rate of 83.33%
- The main goal of performing the action of picking up the object under one minute is achieved

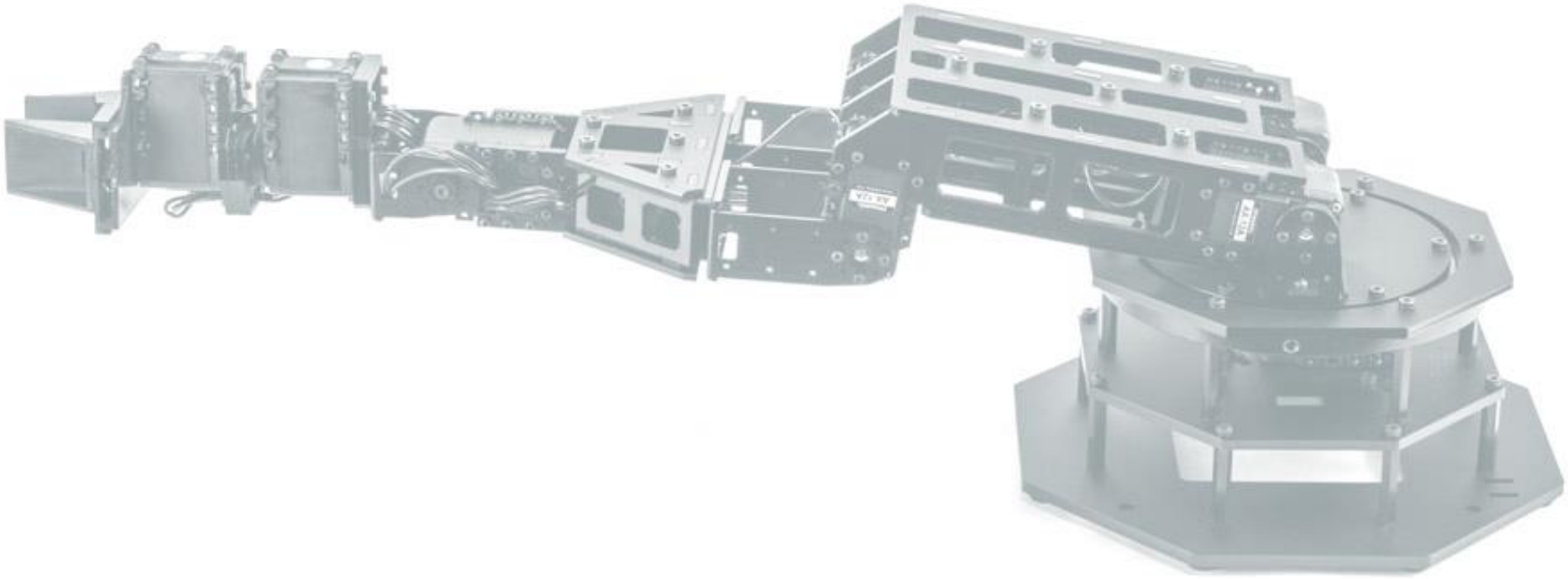
VII. FUTURE WORK

Future work aimed is implementing:

1. The wireless protocol
2. Voice recognition
3. Mind-controlled robotic arm
4. Depth sensors can be used in addition to vision sensors
5. Advanced vision algorithms

VIII. REFERENCES

- Priyanka Karuppiah, Hem Metalia and Kiran George, \Automation of a Wheelchair Mounted Robotic Arm using Computer Vision Interface", *IEEE Publication*, 2018.
- Camilo Perez Quintero, Oscar Ramirez, Martin Jagersand , \Assistive Vision-Based Interface for Robot Manipulation", *IEEE International Conference on Robotics and Automation (ICRA)*, 2015.
- Katherine Tsui and Holly Yanco, \Development and Evaluation of a Flexible Interface for a Wheelchair Mounted Robotic Arm", *Human- Robot Interaction (HRI), 3rd ACM/IEEE International Conference*, 2008.
- Indika Pathirage, Karan Khokar, Elijah Klay, Redwan Alqasemi, \A Vision based P300 Brain Computer Interface for Grasping using a Wheelchair-Mounted Robotic Arm" *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, 2013.
- Hairong Jiang , Bradley S. Duerstock , Juan P. Wachs, \A Machine Vision-Based Gestural Interface for People With Upper Extremity Physical Impairments" *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, 2013.



THANK YOU!

Any Questions?