Final Project Report

Project Title: Autonomous Pick and Drop Robotic Arm

Project Description: This project focuses on building a robotic arm system powered by six servo motors (3 MG996R, 2 MG90S, and 1 SG90) along with a slider mechanism driven by a NEMA17 stepper motor. The robotic arm performs pick-and-place operations using predefined servo angles to achieve precise and repeatable movements. An ultrasonic sensor placed at a fixed location detects the presence of objects, and based on the sensor readings, the robotic arm executes the corresponding pick-and-drop tasks. The system is powered by a 12V 2800mAh LiPo battery, with power regulation handled by DC-DC buck converters (XL4016 and LM2596). An Arduino Uno microcontroller coordinates the motors and sensor inputs to achieve smooth automation. This project demonstrates the integration of robotics, sensors, and embedded systems for object detection and automated handling tasks.

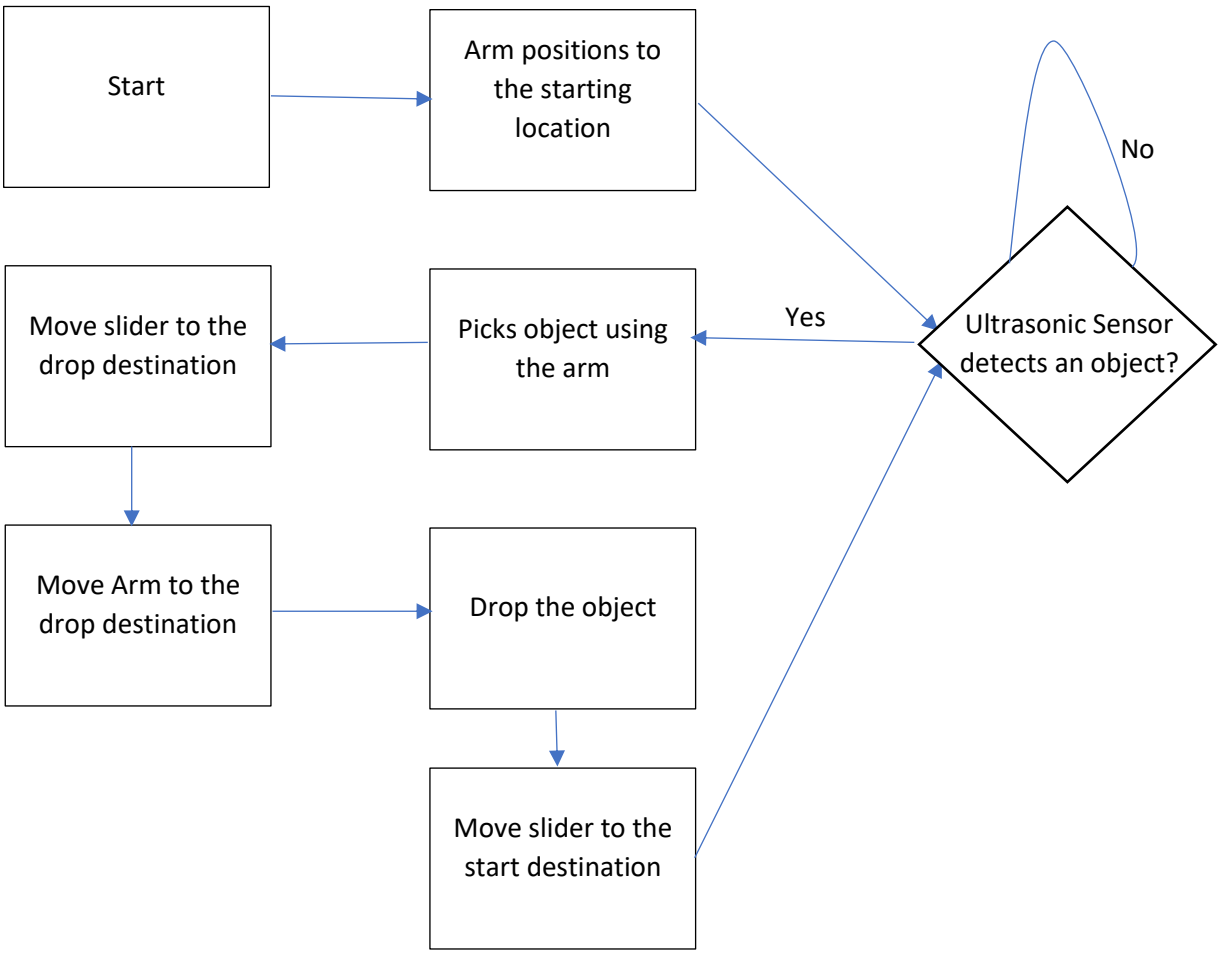
Component List:

Component Name	**Quantity**	**Cost (BDT)**
MG996R Servo Motor	3	1200
SG90s Servo Motor	1	135
MG90s Servo Motor	2	420
Nema17 Stepper Motor	1	1000
A4988 Stepper Motor Driver	1	130
LM2596 DC to DC Step Down Buck Converter	1	65
XL4016 DC to DC Step Down Buck Converter	1	400
Arduino Uno	1	650
100µF Capacitor	1	5
12V Lipo Battery	1	2500
HC-SR04 Ultrasonic Sensor	1	100
8mm Smooth Rod	2	800
CNC Linear Motion Bearing	4	920
GT2 Timing Belt	2	750
GT2 Pulley	1	155
GT2 Idler Pulley	1	137
3D Printed Parts		3000
Jumper Wires		200
		Total Cost: 12567

Working Methodology:

The robotic arm system begins by moving to its predefined starting position, after which the ultrasonic sensor checks for the presence of an object. If no object is detected, the system stops; otherwise, the arm picks up the object using preset servo angles. The slider then moves the arm to the drop destination, where the arm positions itself and releases the object. After dropping, the slider returns the arm to the start position, and the process repeats until no objects are detected.

Working System:



Future Implications/Improvements: In future improvements, the robotic arm can be enhanced by integrating a vision system, such as an RGB or depth camera, along with object detection and pose estimation using computer vision techniques. This would allow the arm to detect and interact with objects placed arbitrarily, rather than relying on fixed positions. Additionally, implementing inverse kinematics and trajectory planning would enable the arm to calculate precise joint angles to reach any target coordinate on the slider, moving beyond preset positions and allowing smooth, adaptive motion for more complex tasks.