UE18CS390B – Capstone Project Phase – 2

SEMESTER – VII

END SEMESTER ASSESSMENT

Project Title   :   Wireless Synchronization of Robotic Arm

Project ID   :   PW22CBR02

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Abstract

- As the technology is growing people are adopting more and more robotics for their comfort.

- The aim is to design a robotic arm which would be used for multipurpose industrial application.

- The main motive is to make the work simple that is to pick heavy objects and place it on the desired location.

- Human hands are slow and inefficient, hence a robotic arm is very helpful for efficient and fast working in a factory.

Team Roles and Responsibilities

Team	Responsibilities
SRINIVAS T NAIK	Hardware and aurdino code implementation
MANJUNATH KJ	Android development
SANDEEP KUMAR S	Android development
GAGANMANOHAR T	Hardware and aurdino code implementation

Summary of Requirements and Design

- **Requirements:**
  - Arduino Microcontroller
  - Android Studio
  - Bluetooth Controller
  - Servo Motors

- In the field of communication we have used Bluetooth instead of Internet. Bluetooth has low chances of connection breakdown and work effectively compared to Internet. But the major drawback is Range, Bluetooth is used for low range communication while we can control devices from anywhere using Internet.

- **Design Approach:**
  We used Agile Approach and Tested the module just after its development is completed. This type of approach helps us to complete the current module before moving forward. Design Approach

Summary of Requirements and Design

- **Constraints:**
    - Limited range as we used Bluetooth communication
    - Can only carry items with limited weight

- **Dependencies:**
    - Manual operation is depended on Android Application
    - Bluetooth is needed for Android and Arduino Communication.

- **Assumptions:**
    - Assume that the item placed in particular place is dragged/brought from conveyor belt. And Assume the place where the item is dropped is some box or storage unit.

- **Risks:**
    - Carrying heavier objects may damages/Overloads servo motors.
    - Restless manual operation may cause connection breakdown.

# Summary of Requirements and Design

- **Design Details:**
  The design approach of Robotic arm is to reduce the burden of workers and losses of Industries. The Robotic Arm is designed in such a way that to carry items safely and placing it to designated place without damaging it.

  We have connected 4 servo motors one at the base for complete rotation of Arm. Two servo motors are connected to elbow to make up and down movement. The last motor is attached to fingers, it helps in closing and opening(Holding and dropping items) of fingers.

  All servo motors can rotate 180 degrees (0-180). The motors in the elbow is connected opposite to each other, so if one motors rotates clockwise(0-180) other rotates anticlockwise(180-0). The combination of clockwise and anticlockwise makes arm up and down movement.

Summary of Methodology / Approach

Model Architecture
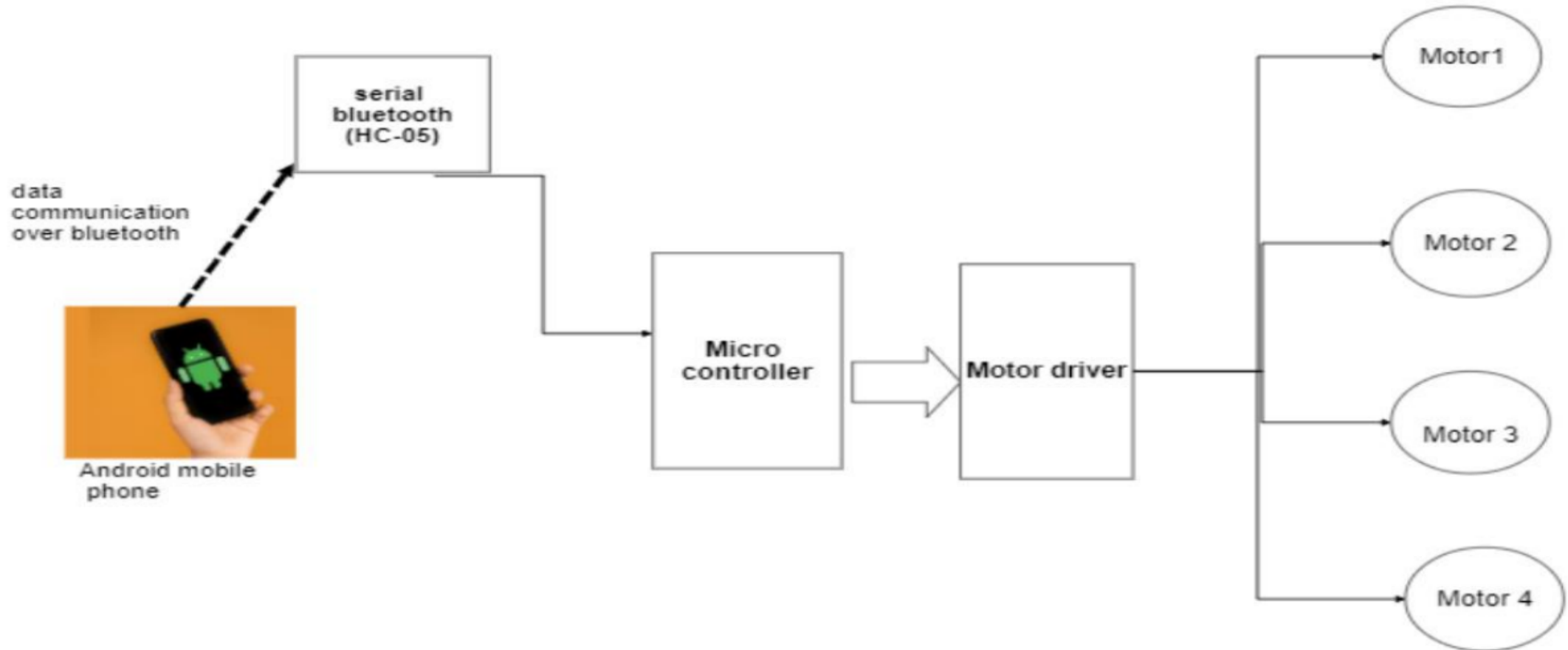
Summary of Methodology / Approach

Prototype/Product based Project

- The design approach we used is to test accordingly with development. That's help is finding flaws as early as possible. So we have used Agile project method. It's easy and everyone in a team will be aware of all the phases of project.

- We could have used many other approaches like timeboxing model so while one person can work on one particular phase and others can work on different approaches. In timeboxing model one person work only for Phase of lifecycle, he will not be aware of other phases of the project.
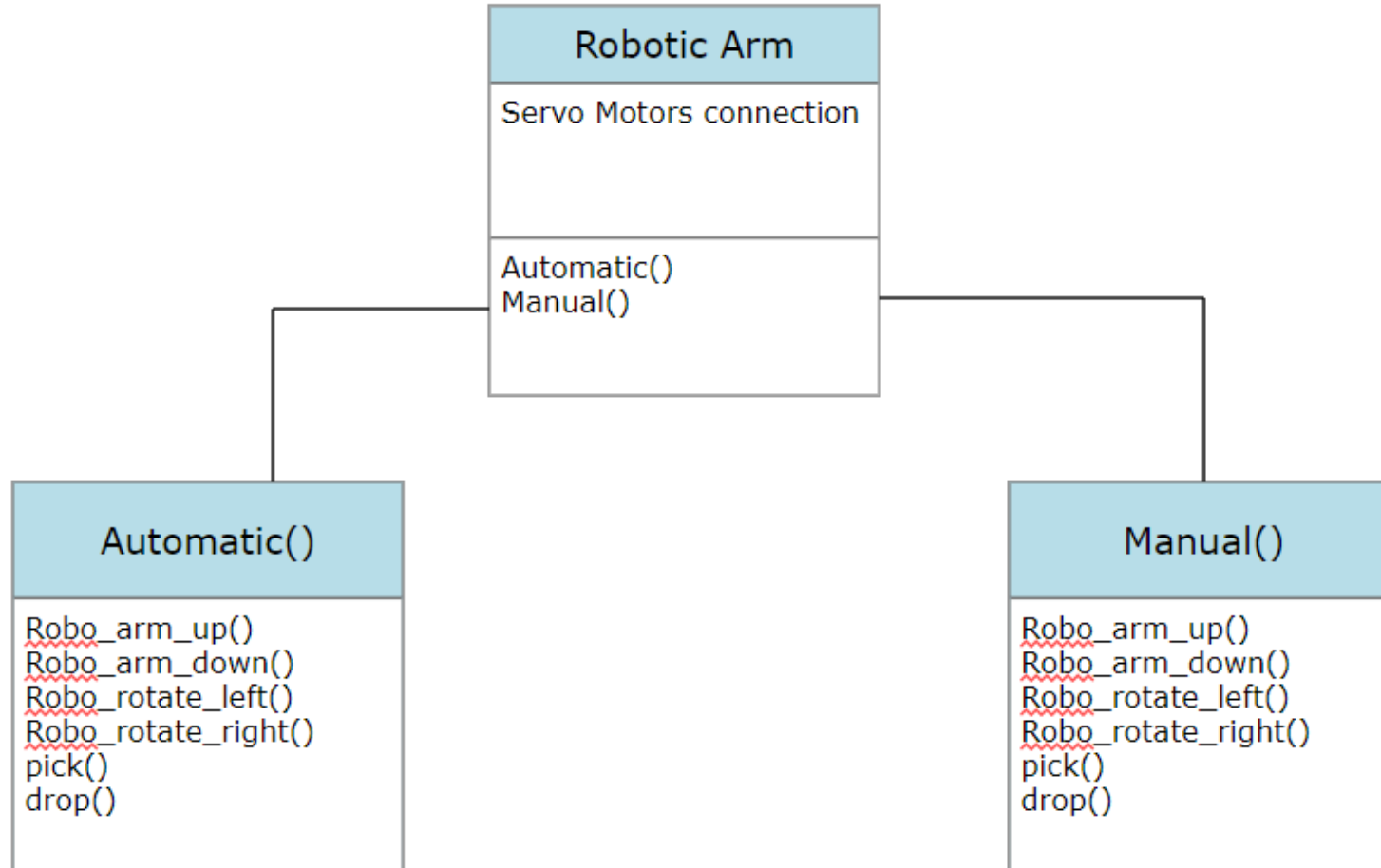
Design Description

Research Project

- As our project has two phases of working, Manual and Automatic
- Project workflow starts from installing android application and connecting it to bluetooth module. Once the device is connected to bluetooth we have option of selecting Auto or Manual mode. If we click on Automatic mode then it works as per the program written in arduino. If we click on Manual mode then we can take control of the Robotic arm and can operate it manually through android application.

Prototype/Product based Project

- Add as many slides as required to cover the following aspects:
    1. Master class diagram
    2. User case Diagram
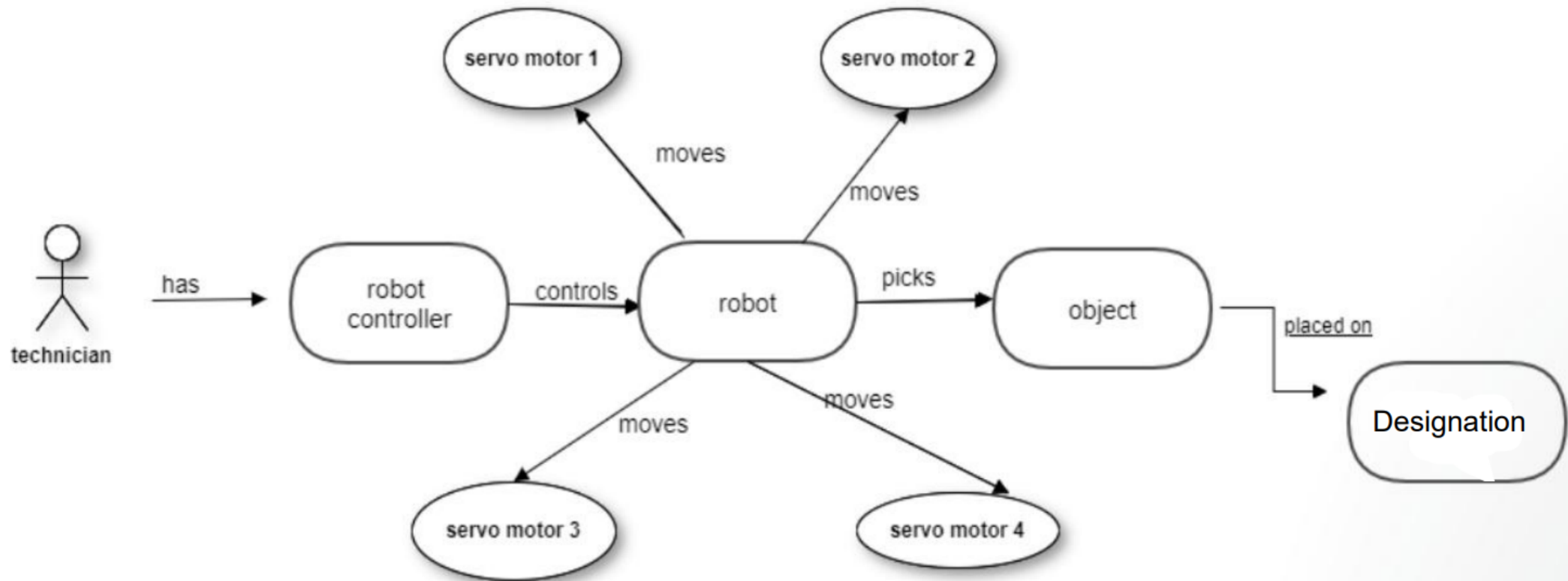   3. Sequence, Packaging and Deployment Diagrams

Design Description

Class Diagram

Design Description

User Case Diagram:

Modules and Implementation Details

- Basically the project has two main modules i.e, Automatic and Manual. Which further has many modules in it.
  - Robo_arm_up, Robo_arm_down
  - Robo_rotate_left , Robo_rotate_right
  - Pick, Drop
  - Reset

  These 6 modules are responsible for both automatic and manual operation of Robotic arm, as it covers all major functionality of the Arm.

- **Robo_arm_up and Robo_arm_down**: As the servo motor is connected to the elbow of the Robotic arm and it helps in up/down movement of the arm. In this module we call the particular servo motor and assign that to move clockwise or anticlockwise. When it moves clockwise the arm gets down and when it moves anticlockwise then the arm goes up.

Modules and Implementation Details

- **Robo_rotate_left , Robo_rotate_right:** The servo motor is placed below the arm is responsible for the rotation of the arm. The servo motor can rotate all 180 degree. If rotate_left module is called then the servo motor goes from 0-180 position and if rotation_right is called then the servo motor goes from 180-0 position. For manual operation we increment 10 degree for every click on the rotation button.

- **Pick, Drop:** The Last servo motor is on the finger/holder. Initially we set the angle to 10 degree and when Drop function is called then the motor goes from 10-90 degree result opening the finger wide. On calling Pick function the opened finger closes from 90-10 degree, if the objects is big then it locks the objects and doesn't closes more that cause damage to the item.

- **Reset:** When the projects starts, it calls reset function and all servo motors goes to the assigned angle. Like servo motor in finger goes to 10 degree resulting closing fingers, motor in elbow goes to 90 degree resulting straight standing elbow, and motor in base also sets to 90 degree resulting center faced arm.

Project Demonstration

☐ Here we have added a video of working project

Test Plan and Strategy

Testing done on the project include :

1. Unit testing - where individual components were tested for ideal functioning. Time taken was 2 days.

2. Integration testing - After unit testing, all components are integrated and thoroughly tested for harmonical functioning between all components. Time taken was 3 days.

3. System Testing - is done as a blackbox testing method where end to end testing of the system is done thoroughly meeting all

Results and Discussion

- Robotic arm was implemented with four degrees of freedom and the motor simulation has been tested.

- The proposed methodology was able to assist the arm movement easily using the developed android app.

- There are different degrees of freedom assisted to each of the servo motors for proper coordination between the robotic arm.

Documentation

Show the evidences, status of the below documents:

- Project report finalized by Guide?

- IEEE (similar) Format of Paper ready for submission or current status? **Which Conferences are you targeting? Have you submitted to any conference/journal? List out.**

- Video (2-3 minutes) of your project? Please Play.

- Add the Github repository link.

- A3 size Poster of your project to be shown.

- All artifacts of your project uploaded in the CSE Project repository?

Lessons Learnt

- We have learnt android studio and to develop android application.

- Learnt to communicate arduino with android application.

- Learnt how to build the project from scratch using different tools.

- We faced some major issues related to communication, sometimes we faced Broken pipe error while communicating between android and bluetooth. It was a programming error and sorted out by adding an exceptions(try/catch) to the program block

Conclusion and Future work

- This project was all about building an multipurpose robotic arm which would be controlled through android app to pick and place the object at desired position thus making our work easy.

- The four degree of movement given to the robot is key highlight .

- The implemented system is validated with the experiment of picking and placing the object to target position.

- Further improvement that can be done to the project is to make it moveable. Remote Access by using camera and Internet. AI to automatically recognize object and place it in particular position.

References

1. R. Yenorkar and U. M. Chaskar, "GUI Based Pick and Place Robotic Arm for Multipurpose Industrial Applications," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), 2018, pp. 200-203, doi: 10.1109/ICCONS.2018.8663079.

2. V. Patidar, A. Mishra and R. Tiwari, "Robotic Gripper Arm System with Effective Working Envelope," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), 2018, pp. 1061-1065, doi: 10.1109/ICCONS.2018.8662945.

3. I. P. Ktistakis and N. G. Bourbakis, "A survey on robotic wheelchairs mounted with robotic arms," 2015 National Aerospace and Electronics Conference (NAECON), 2015, pp. 258-262, doi: 10.1109/NAECON.2015.7443079.

Thank You