Internet of Things Fundamentals J Component Report

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Title: SERV-E

"At your service"

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Abstract

Internet of Things or IoT, a novel network architecture responsible to provide fine grained control over the system hardware, improving resource utilization and simplifying management. Robotic Arms have been used by industries to perform complicated and tedious jobs ever since its introduction in 1962. The application of robotic arms varying from Assembly process to Manufacturing process has led its way towards medical applications allowing doctors to perform surgeries remotely by controlling robotic arm wirelessly.

Here in this project, I have highlighted another approach of robotic arm finding its place in our homes for helping the elderly people i.e., Wireless Autonomous Service bot having Robotic Arm controlled using Arduino. The 3D printed robotic arm can be controlled from any internet enabled smart phone via Bluetooth for short range communications.

Literature Survey

The recent developments in robotics in the previous decade has witnessed Robot Assisted Dressing focused on elderly people which was developed by a team of Massachusetts Institute of Technology, the robotic arm can slide one arm of a vest onto a person. Talking more about the indulgence of robotics in the lives of elderly people involves Smart home automation, Digital Health Reminder for medication/pills and social bots capable of talking to prevent the feeling of loneliness and helps them to be socially active.

[1] Ryan A Beasley - *Medical Robots: Current Systems and Research Directions*
[2] Eftychios G, Christoforou, Sortiris Avyousti, Nacim Ramdani, Cyril Novales and Andreas S. Panayides – *Upcoming Role for Nursing and Assistive Robotics: Opportunities and Challenges Ahead*
[3] MIT Team – *Robot Assisted Dressing*

Problem Statement

With the current boom of technology where the whole world is running towards digitisation and automation, each and every age group of the society is trying to move forward with the current pace. This leads to one of the major problems in one particular age group of our society i.e., the so called 'Frail' elderly people. The constitute among the most neglected section of the society since their age unknowingly forces them to be unable to perform tedious tasks and be dependent on other sections of the society.

As stated by Pennsylvania Home Care, there are 4 major challenges faced by elderly people in their homes

- Loneliness or Lack of Companionship
- Tripping or Falling in an Unsafe Environment
- Inability to Complete their errands
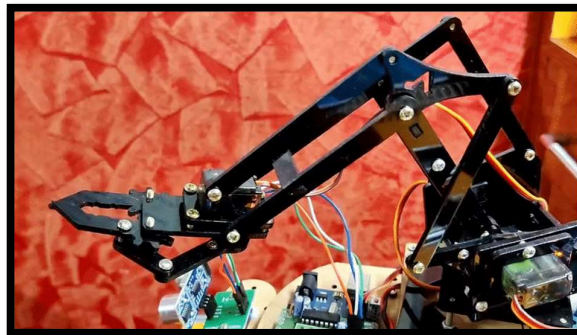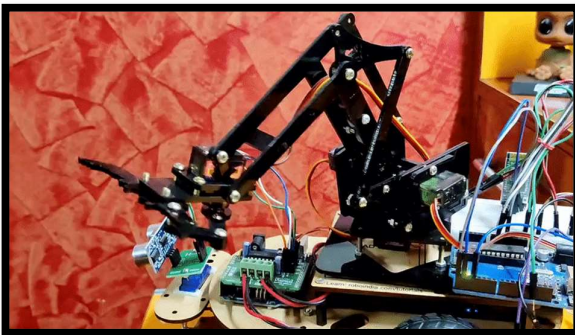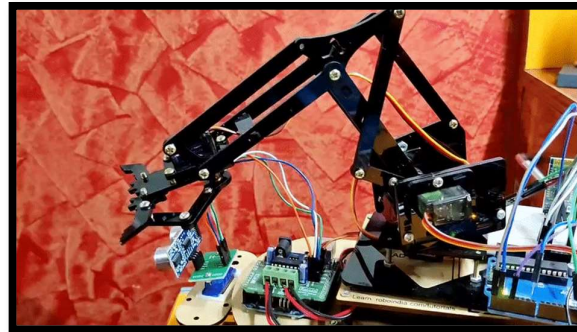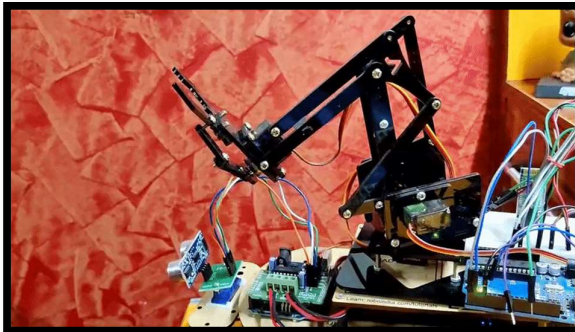- Remembering their Medication

The false notion of elderly people unable to handle themselves with the current technology is something that lacks addressing in the society where they aren't being aware about the things which might reduce their problems up till some extent.
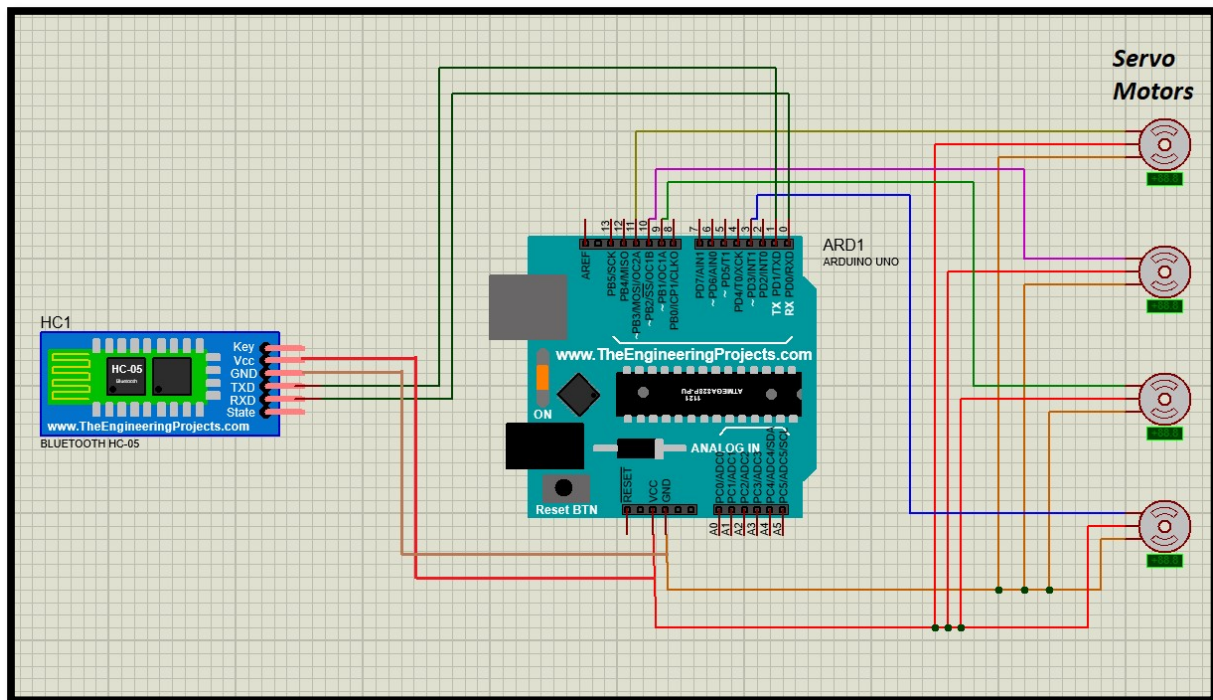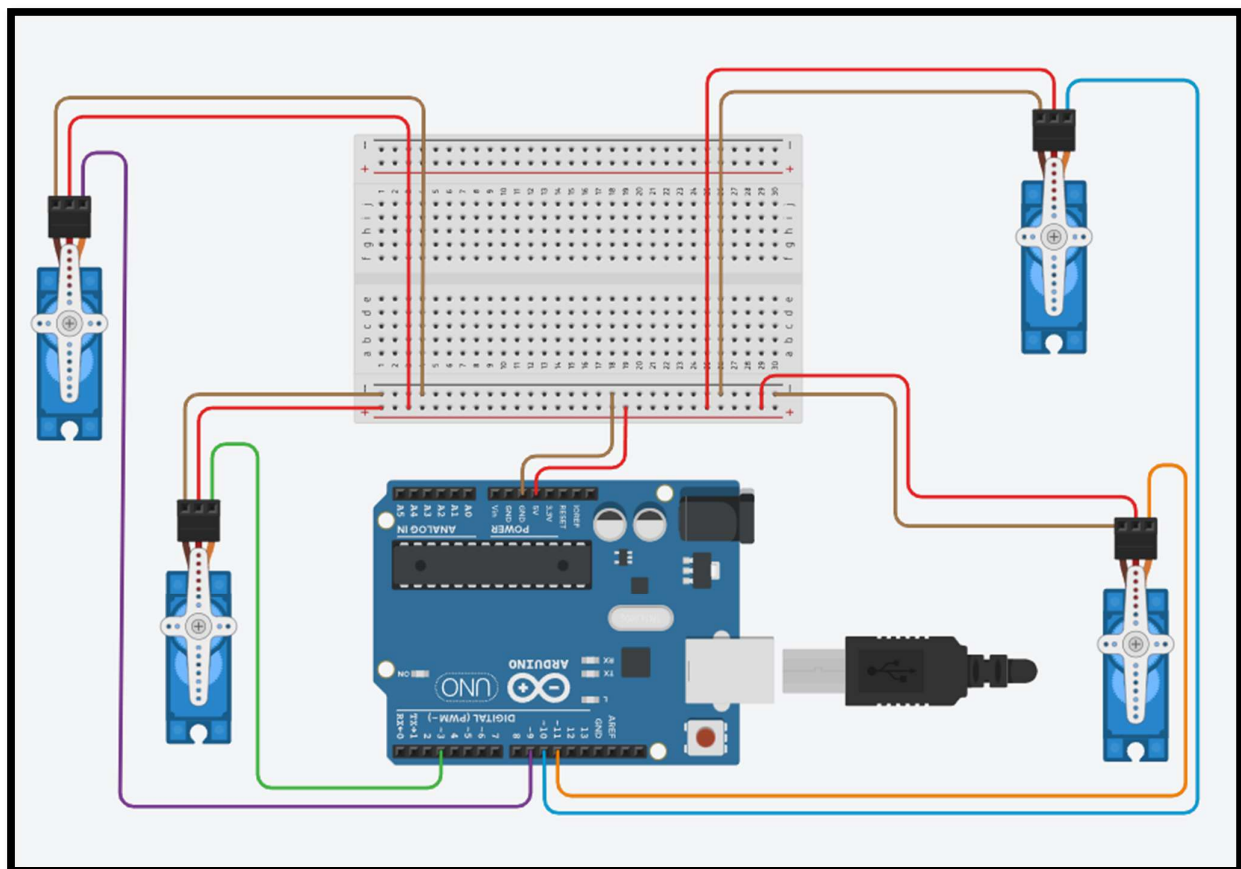
Design Details
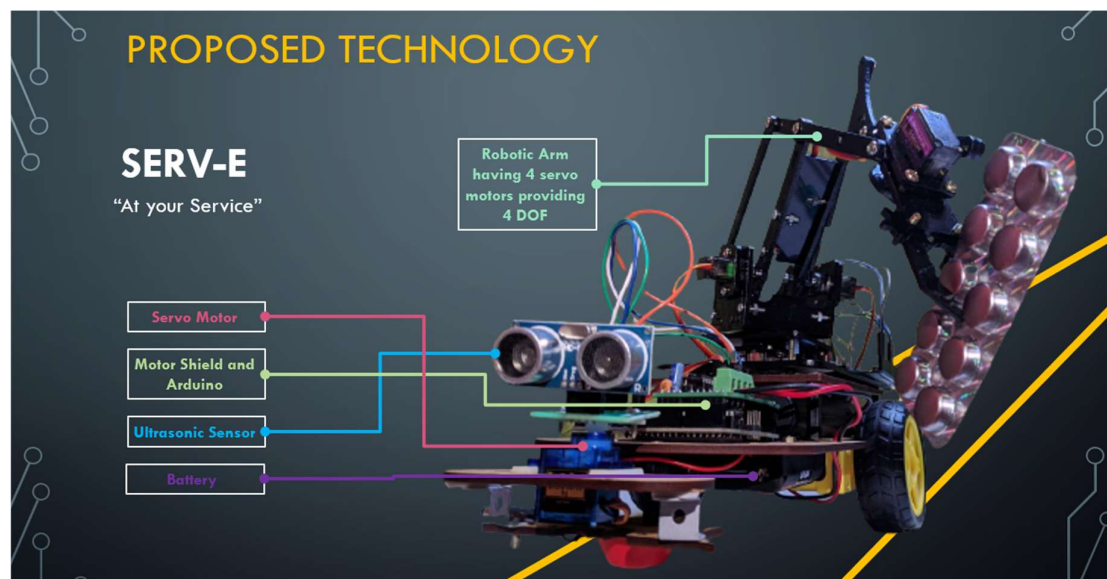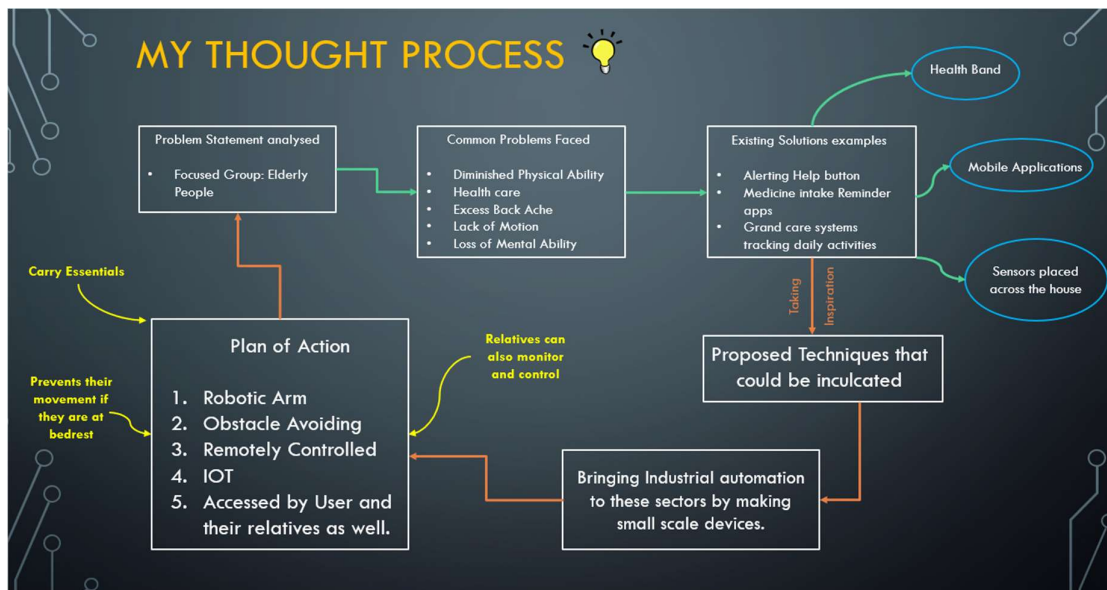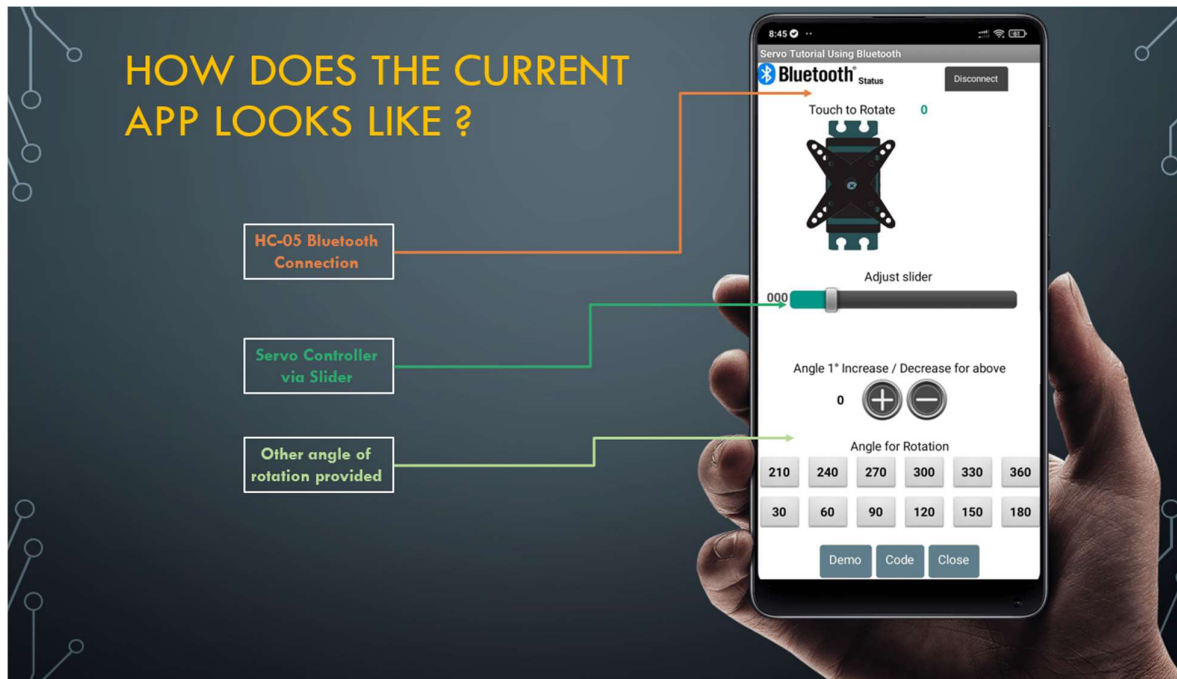
4 Degrees of Freedom of the Robotic Arm

Tinker Cad version (Bluetooth sensor not present)

Hardware Components

Serial Number	Component	Quantity	Role
1	Arduino UNO	2	Brain of SERV-E
2	Servo Motors	4 (MG 90s) + 1 (Micro Servo 9g)	Motion of links is carried out by servo motor joints
3	Motor Shield	1	Controlling speed and direction of BO servo motor
4	HC05 Bluetooth sensor	1	To establish connection with SERV-E via Bluetooth
5	Ultrasonic Sensor HCSR-04	1	Distance Measuring Sensor
6	Breadboard	1	Connection Board
7	Jumper Wires	Male – Female Male – Male Female – Female A lot of them are required	Making connections with different sensors over breadboard
8	BO Motor L type	2	For rotating rubber wheels present at the bottom
9	Battery with DC jack	5xAA cell	Powering up the Arduino 1 responsible for a. Ultrasonic Sensor b. BO motors
10	Rubber Wheels	2	Provides motion to the whole robotic setup
11	ROINCO wooden frame set	1	Builds up the whole setup
12	3d printed Robotic arm set	1	Responsible for placing and picking up the desired items.
13	Power Bank	1	Powering up Arduino 2 connected to the robotic arm and Bluetooth sensor
14	Nuts and Bolts for Assembly	A lot of them is needed	Assembling all the required frames
15	USB Cable	1	Setting up the code on to Arduino
16	Metal Castor Wheel	1	Present in front providing motion
17	HC-SR04 base module	1	For mounting Ultrasonic on to servo

Software Components

Serial Number	Software	Role
1	Arduino IDE	Setting up the entire code and importing the required libraries for the overall functioning of the robot.
2	Proteus	Making the electrical architecture and performing the simulations as well.
3	Tinker CAD	Making rough electrical architecture
4	MIT App Inventor	Building up the app for the control of servos via Bluetooth

Working Mechanism

- **SERV-E Description**
    a. After a lot of Ideation and Brainstorming, I present you SERV-E "At your service", a state-of-the-art robot having its own non holonomic 4 DOF robotic arm.
    b. The purpose of the project was to help the neglected section of the society i.e., the elderly people who aren't engaged with the growing technology.
    c. In the current stage the robot is able to navigate by avoiding any obstacle present in front of it.
    d. What all does SERV-E provides?
        (a) SERV-E's robotic arm is entirely controlled by the user.
        (b) The ultrasonic sensor present in the front is responsible for avoiding any obstacle present in front of it
        (c) The user can control the motion of robotic arm by picking and placing their desired objects.
- **About the Code!**

    a. **ARDUINO 1**

        ♦ The first brain is responsible for the functioning and control of ultrasonic distance sensor along with the 2 BO motor controlled via motor shield.
        ♦ The maximum distance to avoid any obstacle was assigned to be 50 cm
        ♦ The micro servo which mounts the HCSRO4 sensor tends to rotate 180 degree at the time when it detects obstacle within the range specified.
        ♦ We define the function for the directions → Forward, Right, Left, Back and Stop and use the digitalWrite to control the specific BO motor.

    b. **ARDUINO 2**

        ♦ The second brain which plays the most important role i.e., controlling the robotic arm is done through this Arduino

- ♦ Along with the control of robotic arm is the connection of Bluetooth sensor for the control of robotic arm.
- ♦ Following is the key component of the code which determines the movement of each link in the robotic arm via servo motors acting as joints.

```
Void loop() {
  if(Serial.available())
  {
    Text = Serial.read();
    Spilt = Spilt + Text;
if (Text == '*') {
    Serial.println(Spilt);
    Spilt = Spilt.substring(0, Spilt.length() – 1); // Delete last char *
    k1 = Spilt.indexOf('*');
    angle = Spilt.substring(0, k1);
    myservo.write(angle.toInt());
    ms2.write(angle.toInt());
    ms3.write(angle.toInt());
    ms4.write(angle.toInt());

//    delay(15);
    Spilt = "";
  }
```

- **What does the User need to do?**
  a. Power up the second Arduino by connecting it to the power bank
  b. Open your device and turn on your Bluetooth to connect with the HC05 sensor
  c. Open the app which was made for controlling the servo motors
  d. After a successful connection you are now ready to control the robotic arm
  e. Now, make sure to power up the Arduino 1 through the battery jack and off the robot goes.

Features covered from IoT point of view

- The first and foremost priority was given to BLYNK platform which I wasn't able to configure due to the excessive time it took
- As an alternative approach I followed Bluetooth approach, though the current sensor uses Bluetooth 2.0 technology but the latest version Bluetooth 5 has four times the range, double the speed and 800% more data broadcasting frequency, as compared to its earlier versions.
- Bluetooth Low Energy, a version of Bluetooth designed for low powered devices can help IoT devices conserve energy.

Results Obtained

Google Drive Link:
https://drive.google.com/file/d/1b53dQYFblUfnpu0WK9wbquB5Bo5hbreM/view?usp=sharing

Future Scope

I initially aimed to cover a lot of aspects but due to the time and resource constraint, the project was left uncompleted. Following I have highlighted what all can be done to make it much better than the first version.

- The current version is a single layer robot but there could be multi levels to have different compartments for putting up the desired objects for the user.
- Because the current version still works via Bluetooth, I want it to have fully enable IoT services to monitor everything such that the control could also be accessed by user's relatives living at different location.
- The future could see inculcation of neural networks to make the robot much more autonomous in terms of mapping the house and specifying important locations along with the ability to speak to the user as well.

Problems Faced

- I created to assign the control of each servo to the user. The prior goal was to fix the broken pipe error which I was facing because of the app created using MIT App inventor but I wasn't able to figure out for the same.

References

[1] Robotic Arm control having 5 DOF
[2] Robotic Arm using Node MCU configuration with Blynk IoT platform
[3] Arduino controlled Robotic Arm
[4] YouTube video links for the same
- https://www.youtube.com/watch?v=LBNRGBY5zN8
- https://www.youtube.com/watch?v=lEV_0uFFpBU
- https://www.youtube.com/watch?v=F0ZvF-FbCr0

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