CS-308-2016 Final Report

Seed Sowing Bot

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Table of Contents

1. Introduction

In this age of rapid urbanization we need automation systems for agriculture. The focus is shifting towards rooftop farming and in order to reduce manual effort we want to automate the process of seed sowing. In this project we aim to build a seed sowing bot.

2. Problem Statement

Seed sowing consists of two main operations.

1. Digging a hole in the soil
2. Placing the required number of seeds in the slot

These two operations need to done at regular intervals to maximize the crop for a given plot. Our work will reduce manual labor and time required to sow seeds and do it more efficiently.

3. Requirements

3.1 Functional Requirements

Our bot must meet the following functional requirements
1. Dig the soil at regular intervals
2. Place the specified number of seeds in the hole
3. Navigate the grid efficiently in order to minimize power consumption

3.2 Non-Functional Requirements

The following are the non-functional requirements
1. Price : Rs. 3000 (based on initial estimate)
2. Portability : since bot needs to work with roof top farming, it needs to be portable
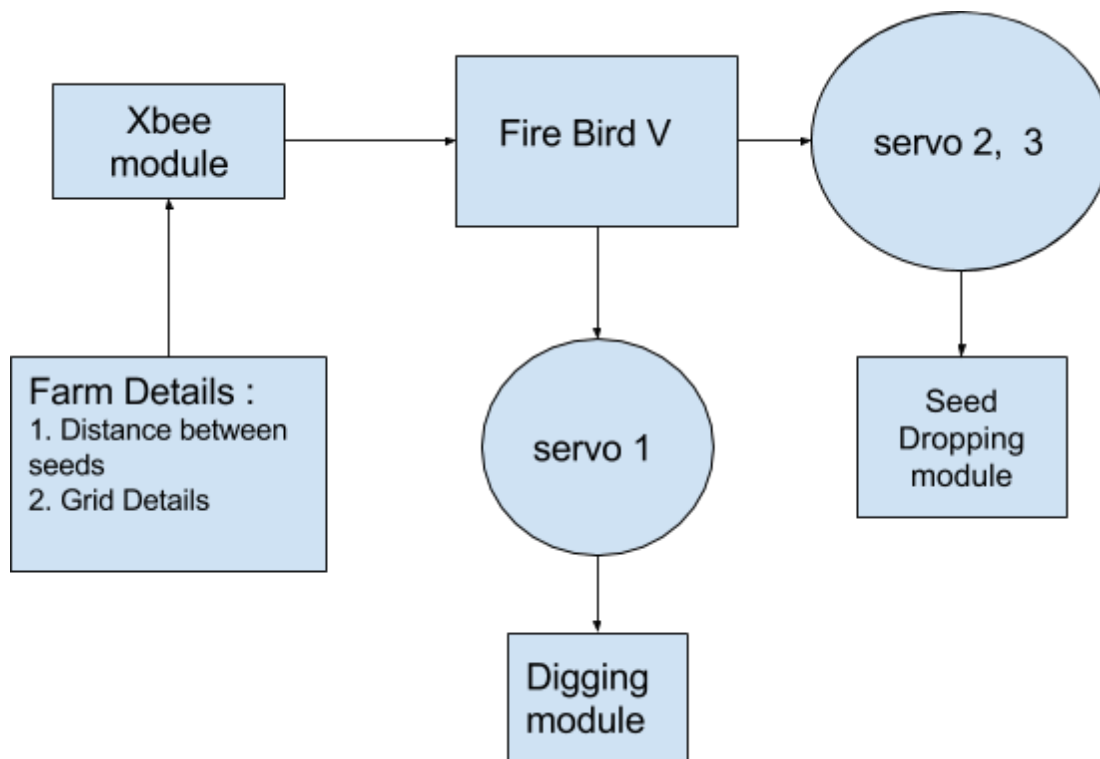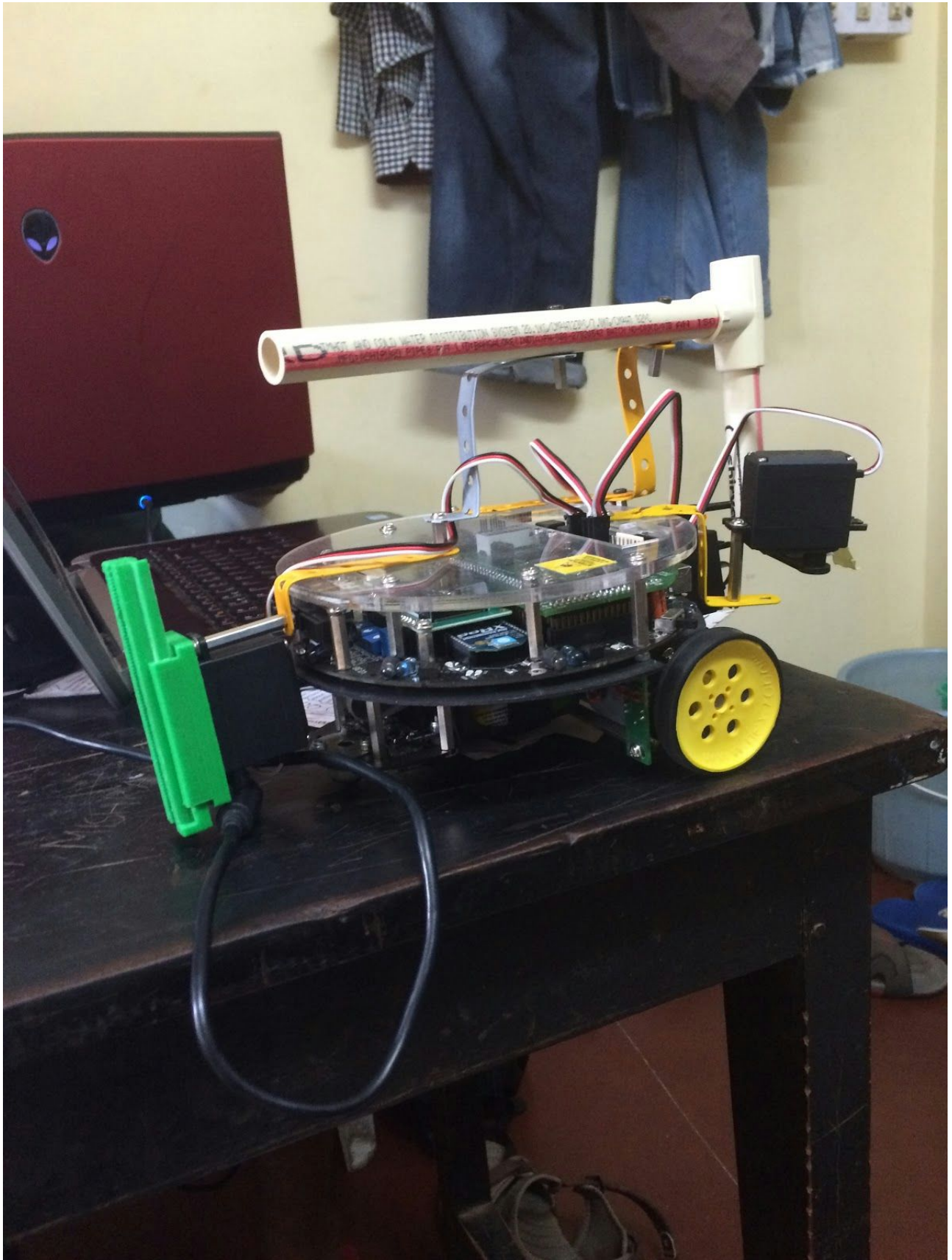
3.3 Harwdare Requirements

1. Fire Bird
2. Xbee modules for communicating with Fire Bird
3. IMU sensor for navigating the grid
4. Mechanical parts for digging and holding seeds
5. Servos for digging and dropping the seeds

3.4 Software Requirements

1. Eclipse with avr plugin or AVR studio with AVR Bootloader
2. XTCU for configuring xbee moudle and communicating with the bot

4. System Design

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┌──────────┐         ┌──────────────┐          ╭───────────────╮
│  Xbee    │ ──────► │ Fire Bird V  │ ───────► │  servo 2,  3  │
│ module   │         │              │          ╰───────────────╯
└──────────┘         └──────────────┘                  │
     ▲                      │                           ▼
     │                      ▼                   ┌──────────────┐
     │              ╭───────────────╮           │    Seed      │
┌──────────────────┐│   servo 1     │           │  Dropping    │
│ Farm Details :   │╰───────────────╯           │   module     │
│ 1. Distance between│       │                   └──────────────┘
│ seeds            │        ▼
│ 2. Grid Details  │  ┌──────────────┐
└──────────────────┘  │  Digging     │
                      │  module      │
                      └──────────────┘
```

5. Working of the System and Test results

Digging Module :

The digging module used in our project is custom 3d printed part that fits on a servo and has an arm that moves vertically when servo rotates similar to a linear actuator. A similar immovable arm is used on the opposite side of the servo rotor for support
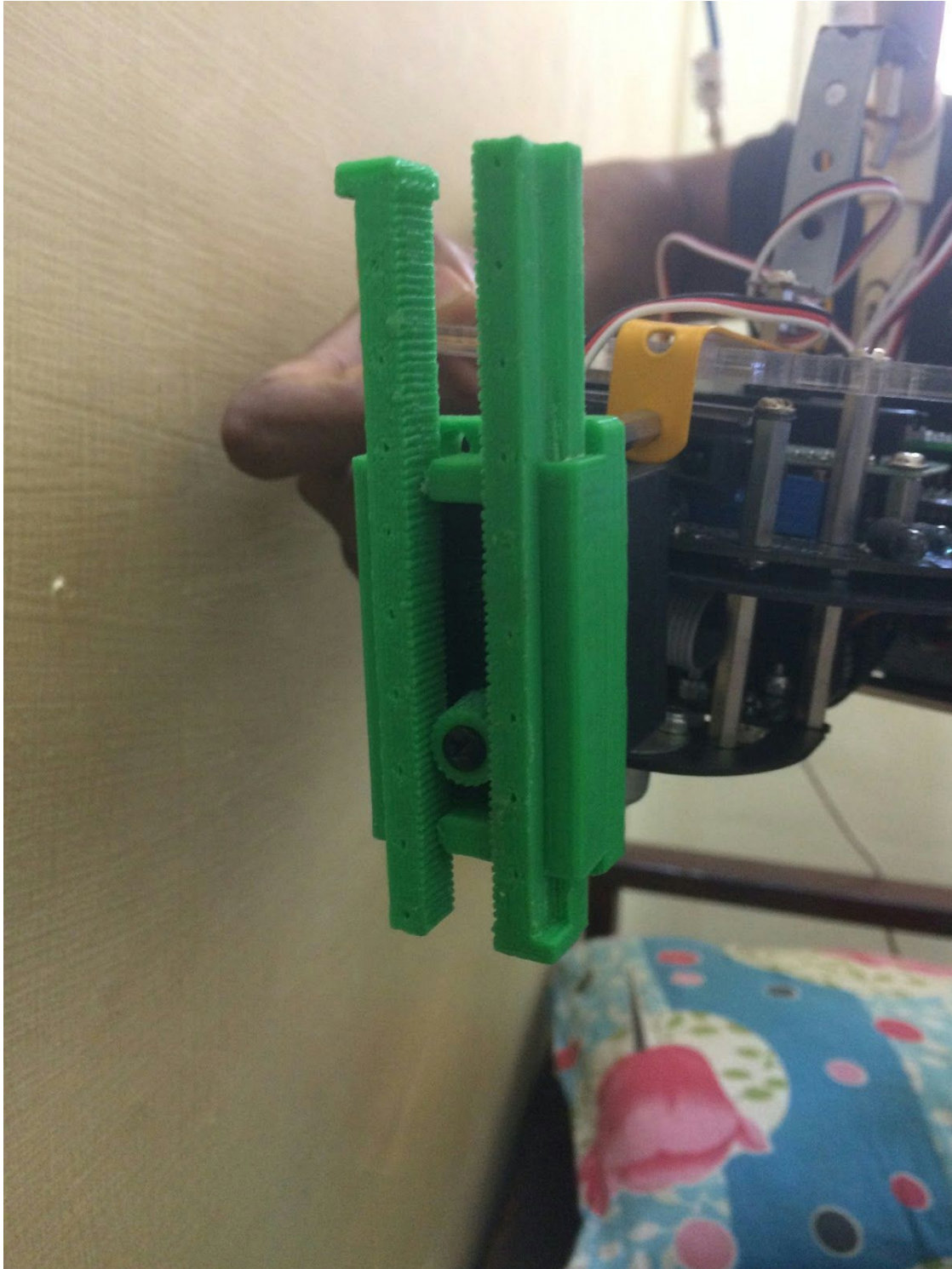
Seed Dropping Module :

The seeds are placed in a vertical pipe fixed to fire bird. As the servos cannot move quick enough to facilitate single seed drop from the pipe, a slot is made in the pipe for a second servo arm to be placed in it, so that space between the servo arms hold exactly a single seed. The alternative opening and closing of these arms made the mechanism single seed drop possible.
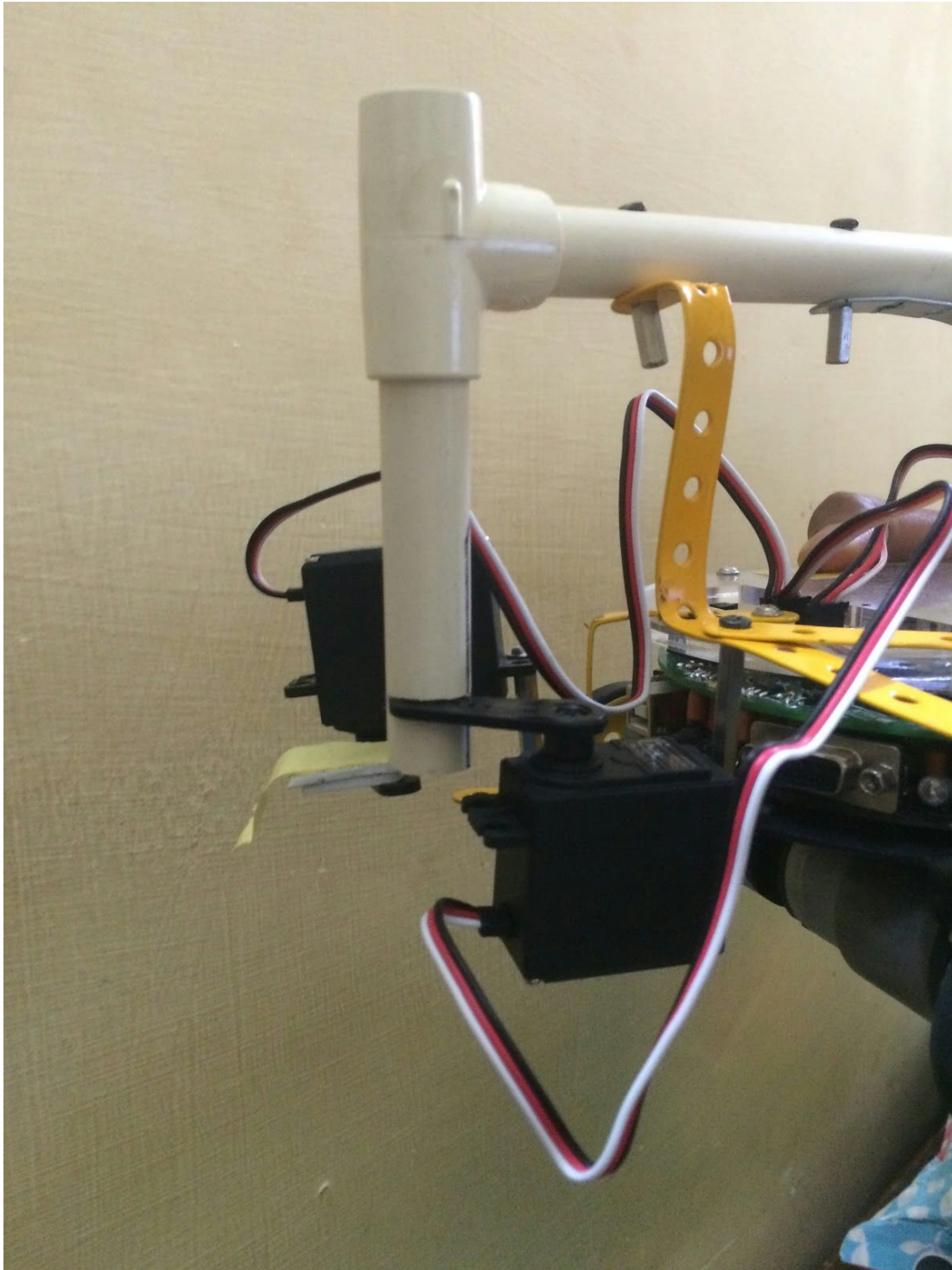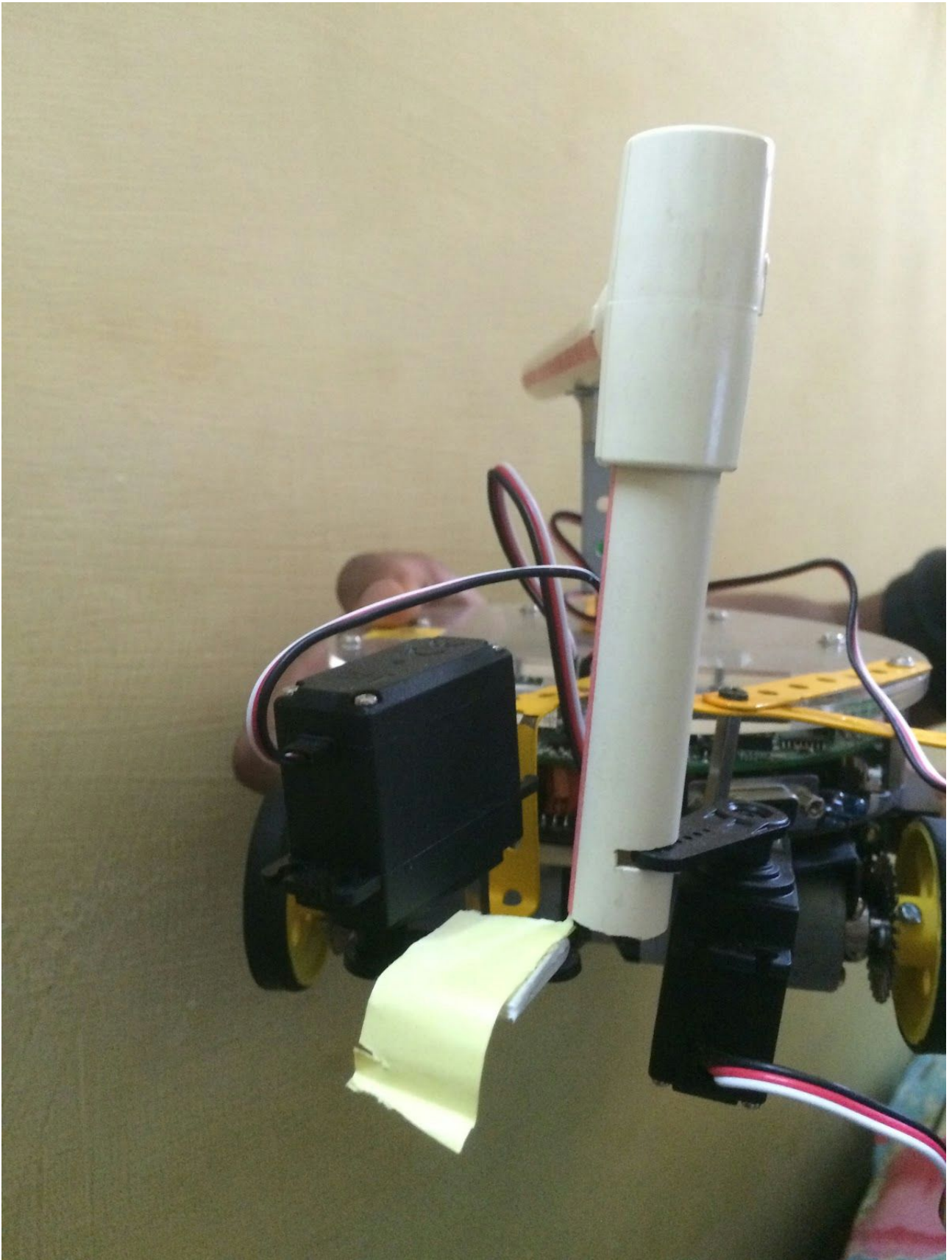
Functionality Testing :

The distance between two digging locations is constant can be tested using a scale. Also, the location of seed drop coincides with the location of the dig.

6. Discussion of System

a) What all components of your project worked as per plan?
Digging and seed dropping worked as per plan. Magnetometer could not be implemented. Used manual calibration instead. Also provided white line follower as a backup.

b) What we added more than discussed in SRS?
Manual calibration of the bot along with white line follower were added.

c) Changes made in plan from SRS:
Web App has been elimintaed from SRS and controls were provided from XBee module.

7. Future Work

Magnetometer can be implemented for better navigation in straight lines. App can be created for givinginputs of distances between seed sowing.

8. Conclusions

The bot can be used for sowing seeds in simple environments. The bot can dig into soil and then sow the seeds greatly reduccing the effort of manual labour. The starting of the bot can be controlled manually and therefore the person can make sure the soil is ready for sowing.

9. References

   a. https://www.cse.iitb.ac.in/~erts/