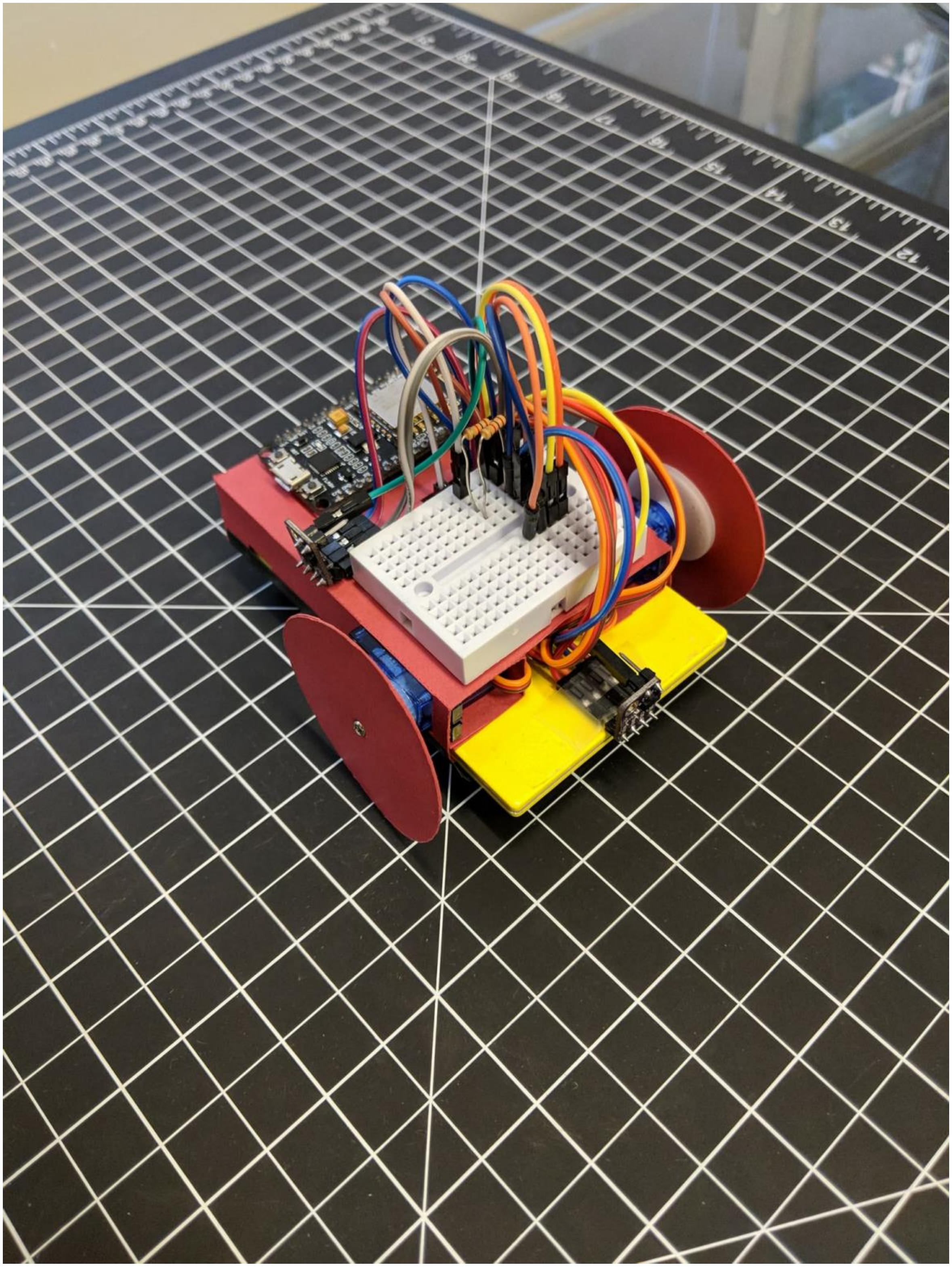
# Lab 3 Getting Started Guide



## Introduction

In this lab, we will perform localization on a paperbot. This guide has been created to help you get started and potentially save a significant amount of time that would have otherwise been spent debugging.

## Components

Each group will be given a kit consisting of the necessary parts to complete the lab. These kits include the following materials and components

1x Paper robot cutout
4x Wheel cutouts
1x Prototyping breadboard
1x Battery
1x ESP8266
1x ESP8266 motor shield
2x continuous rotation servo motors
2x vl53l0x range sensor with header
1x MPU9250 with header
An abundance of jumper wires

## Hardware

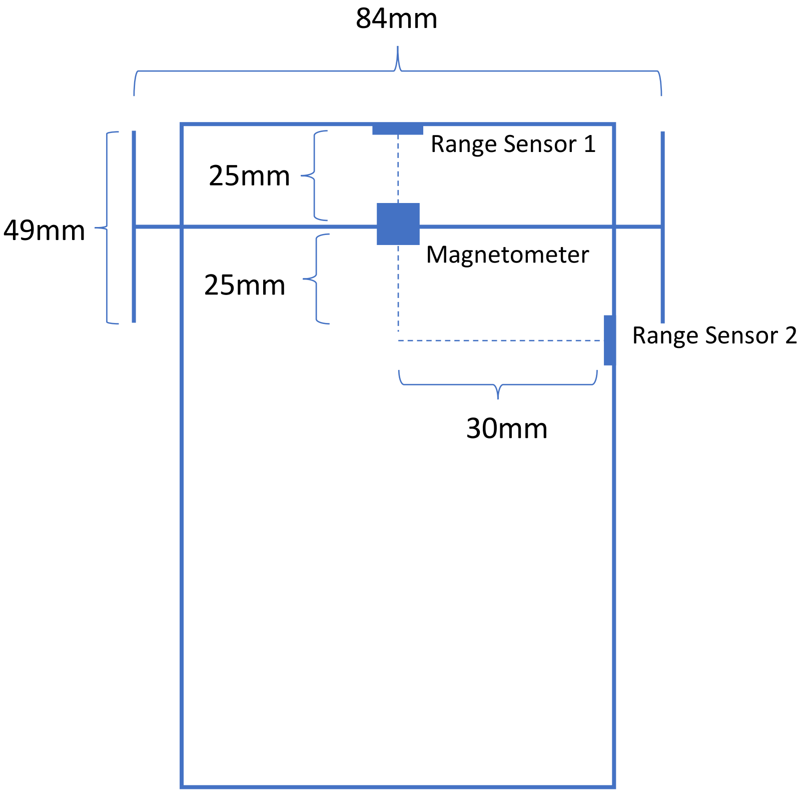
## Folding the robot

The paper cutout that has been provided will fold into the paperbot that will be used for this lab. Follow the sequence of photos in the Paperbot construction folder to see how to perform the folding sequence correctly. Note that for extra strength the wheels should be glued together before being screwed into place.

Physical specifications

After folding, the paperbot should have roughly the following dimensions

- Axle length: 84mm
- Wheel Diameter: 49mm
- Lateral sensor to axle distance: 25mm



The above diagram shows the relevant dimensions that will be needed for modelling the system. The configuration of the sensors is only a suggestion and can be changed according to however you think is best to perform localization. Note that the offset of the first and second range sensors need to be accounted for in the system model if you choose to stick with this configuration.

## Wiring

A wiring diagram for the ESP8266 to the sensors is available in the folder of this document. Note that the externally exposed pins are the only ones necessary for wiring the paperbot. Secondly the 1K resistors that are used as pull-ups on the SDA and SCL lines can be replaced with other lower valued resistors if necessary eg. 330 ohm.

## Software

The software that will be provided to you in this lab is in three separate packages, basic segbot movement code, vl53l0x sensor test code and MPU9250 sensor test code. The code functions independently but needs to be merged together to form a cohesive unit. Note that this is just meant to get you up and running and that the final code will likely look very different to

### Paperbot movement code

This code was created by the LEMUR lab and is available here or can be found in the same folder as this document. Follow the instructions on the website to get the robot moving.

## Sensors

### Range sensor

In order to extract range measurements we will use the Vl53l0x range sensing unit. This device communicates over I2C. For your convenient a script (vl53l0x_duel_sensor_test.ino) has been provided that can be used to check the communication link between the two sensors. In particular is should be noted that the two devices will have the same I2C default address and so the addresses need to be changed so that both of the units can be communicated with simultaneously. In order to do this, we use the xshut pin on the device which acts as an enable pin. Enabling a device by driving the xshut pins high whilst driving the xshut pin for the other device low, allows the device addresses to be changed independently.

Note in order for the code to work the vl53l0x-arduino-master folder needs to be moved into the library folder in your computers Arduino folder.

### Magnetometer

The second sensor that we will be using is the MPU9250 9DOF accelerometer, gyroscope and magnetometer. You are welcome to use any of the devices sensing capabilities however the magnetometer should be sufficient for this lab. As with the previous sensor code has been provide which can be used to test the I2C communication with the sensor. An important note however is that the heading reading is very crude since no calibration takes place with the current script. Calibration is application specific and needs to be performed on a per unit basis. More information and implementation details on this can be found here. Furthermore, if you would like to access more of the features of the device, code for that can be found here.