

Swarm Robotics

ECN-578 Course Project Report

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Abstract—Swarm robotics is an approach to the coordination of multiple robots as a system which consist of large numbers of mostly simple physical robots. It is supposed that a desired collective behavior emerges from the interactions between the robots and interactions of robots with the environment. This approach emerged on the field of artificial swarm intelligence, as well as the biological studies of insects, ants and other fields in nature, where swarm behaviour occurs.

Index Terms—Line following, Swarm robotics, Node MCU 1.0, IoT

I. INTRODUCTION

Swarm robotics is an approach to the coordination of multiple robots as a system which consists of large numbers of mostly simple physical robots. Under the excuse of this project, we made a bot that copies the movement of the other bot without any delay. The aim of the project was to make the bot that will copy the movement of the line following bot.

This report is divided as follows. Section II lists the components used to build this project. Section III explains the working of our project. Section IV lists the use case of our project. Section V lists the challenges we faced.

II. COMPONENT USED

The major components that are used in this project are as follows:

A. LSA-08

LSA-08 [2] is the Advanced auto calibrated Line following sensor. It consists of 8 IR transmitter and IR receiver pairs. LSA-08 is typically used for embedded system or robots for line following task. LSA-08 can detect any color of line which has brightness different with the background. The IR transmitters on LSA-08 are pulsed to allow the transmitter to off at certain idle period of sensor. This minimizes the current consumption of LSA-08 to at least half of the current consumption compared to a normal unregulated IR line sensor. Power polarity protection is available on LSA-08 in case the user accidentally applies a reverse voltage.

B. TiVA Launchpad

The EK-TM4C123GXL [4] LaunchPad is a very capable board with a 32-bit 80MHz ARM Cortex-M4F processor. It has many peripherals so it's possible to do some pretty high performance applications. It also has a very bright RGB LED.



Fig. 1. LSA-08

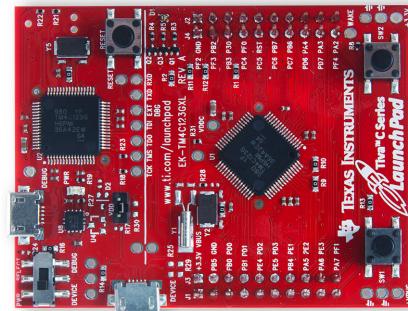


Fig. 2. Tiva Launchpad

C. Node MCU

Node MCU [1] is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. **Note:** Several other small

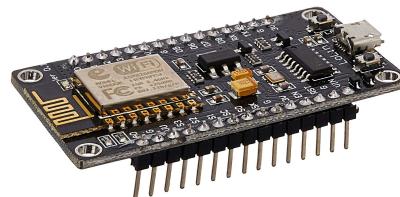


Fig. 3. Node MCU 1.0

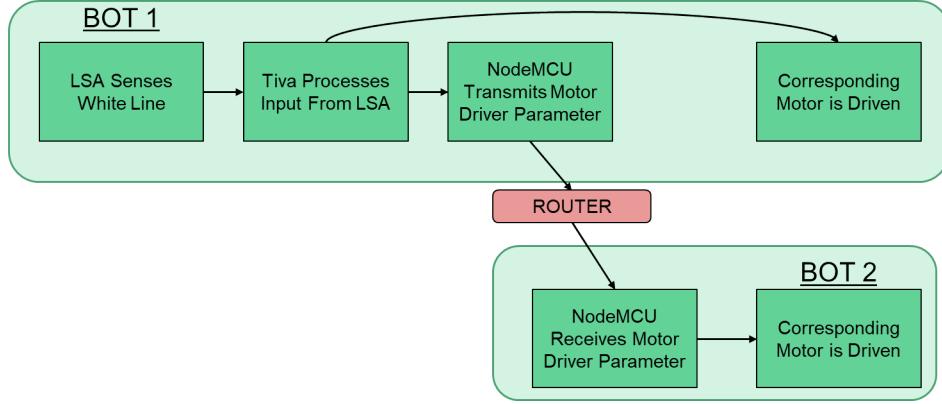


Fig. 4. Block Diagram of working

components are used to make the hardware design which includes motor, battery, car chassis, jumper wires etc.

III. METHODOLOGY

The idea is to make the line following bot, whom we will be calling as Bot 1 from now, and transmit the same control to the another bot, Bot 2, so that it can copy the movement of Bot 1.

A. Making of Bot 1

Bot 1 is a line following bot. It uses the LSA-08 to perform the aforementioned functionality. The LSA-08 is calibrated to read as white strip as '1' and read the black background as '0'. These readings are sent to the Tiva board. Here some processing is done that calculates the speed and direction in which the motor drivers must be driven. This calculated data is first sent to the Node MCU and then to the motor driver of Bot 1. This order of transmission is done to minimize the delay in communication between Bot 1 and Bot 2. The Node MCU sends its data to a WiFi server that broadcasts it to any active Node MCUs. The motor driver drives the wheels according to the information it receives.

UART transmission is done between the Tiva and nodeMCU with baud rate of 115200.

B. Making of Bot 2

This bot comprises a nodeMCU and a motor driver and other basic components. The nodeMCU simply receives the data and sends it to the motor driver. The motor driver then drives the wheels of the bot.

C. Processing done

The outputs of the LSA-08 are treated as weighted input to the Tiva Board. The weights we choose were [1, 1, 1, 1, -1, -1, -1, -1]. A weighted sum of these inputs was calculated as 'wSum' and logical statements were executed based on the following logic.

if All inputs are 0 **then**

HALT - Since we can't find a line

else if wSum == 0 **then**



Fig. 5. From left to right - Bot 2, Bot 1

FORWARD - Continue on the line

else if wSum > 0 **then**

LEFT - Turn left by driving the right wheel only

else if wSum < 0 **then**

RIGHT - Turn right by driving the left wheel only

end if

IV. USE CASE

Testing of our bots was done on an arena made by white strips on a black chart paper. As soon as a line was detected the bot 1 immediately followed it and the bot 2 copied the movements made by bot 1.

V. CHALLENGES AND FUTURE SCOPE

A. Challenges

- Using UART [3] between TIVA Board and Node MCU as we have to set equal baud rate on the both the microcontrollers.
- Interfacing of two node MCU such that the delay is minimum and maximum number of data packets are transmitted.



Fig. 6. The Play Arena

- Optimizing code to minimize the delay on the TIVA Board.
- The speed of the bot was too high for our track making it follow a sinusoidal path. A slower bot would have performed better.

B. Future Scope

- Including PWM for Speed control of Motor
- Including PID control for the Line Following Bot
- Relative positional awareness is not present in our bots. That is a challenging task and a problem of interest for further study.

VI. ACKNOWLEDGMENT

We would like to thank Prof. Bishnu Prasad Das for giving us the opportunity to do this project, teaching the prerequisites for this project and sponsoring the project.

VII. CONCLUSION

Through this project we were able to make a bot copy a line following bot using Node MCU for communication and Tiva board for processing and were able to successfully test them on our demo arena. This report also details the issues we faced and improvements that can be made in the future.

REFERENCES

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