CS695- Autonomous Water Irrigation System

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Agenda

- Motivation
- Components Used
- Design Diagram
- Pin Configuration
- Testing Process
- Testing Result
- Demo
- Planned vs Actual Accomplishments
- Lessons Learnt

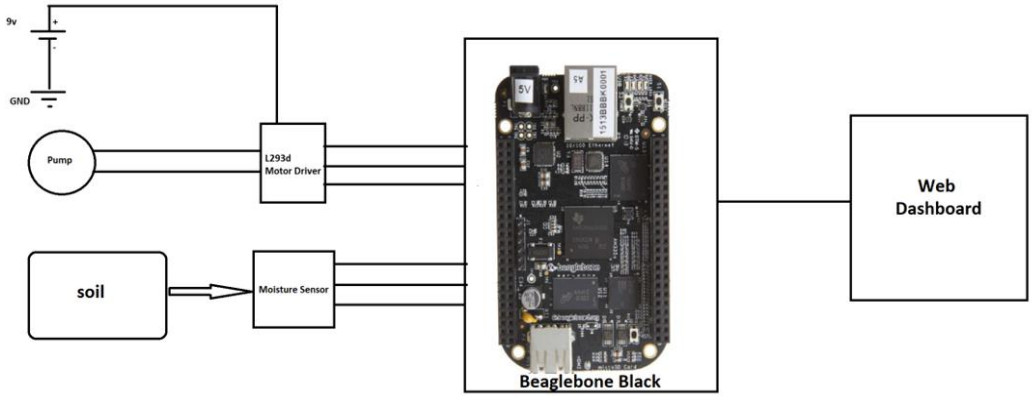
Motivation

The embedded systems are used in various day-to-day applications. The challenge is to fit automation into the daily life of people, rather than to make them adapt to the technology. In this project, the irrigation process is automated for home gardens, small agricultural farms and wherever possible. The user should also have the freedom to control the irrigation process. In order to make it user customizable product, the irrigation process can be monitored over the internet.

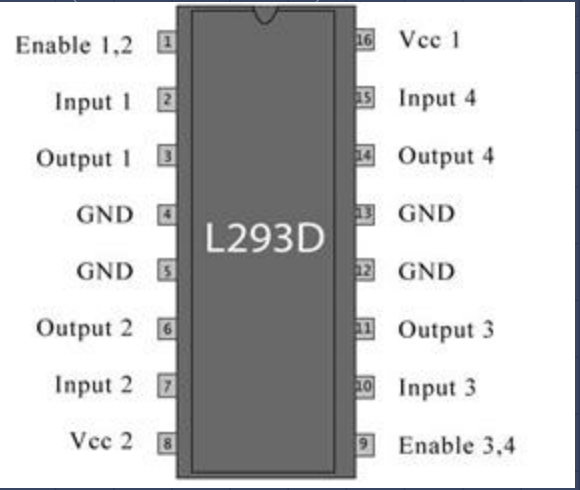
Components Used

- Beagle Bone Black
- DC sub-immersible pump
- L293D H-bridge motor driver
- Soil moisture sensor
- Breadboard
- 10k ohm resistor

Connection Diagram- Overview

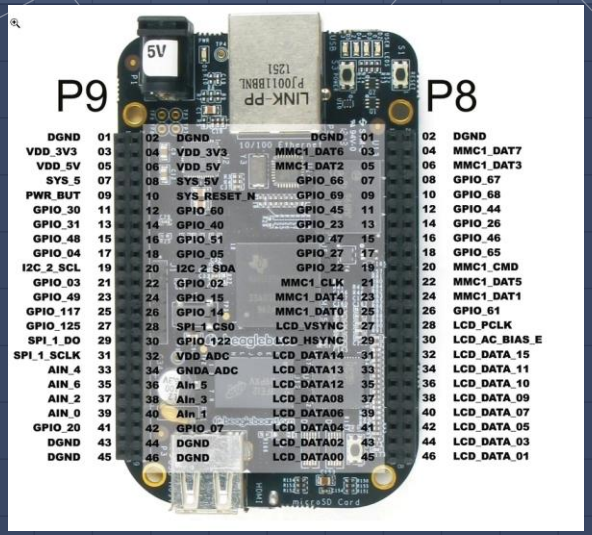


Pin Configuration- L293D



- Pin 1 and 9 -> connected to GPIO and made HIGH to enable the H-bridge driver
- Pin 8 and 16 -> connected to 5V received from Beagle Bone Black
- Pin 12 -> GND
- Pin 15 and 10 -> Receives input from Beagle Bone Black GPIO pins
- Pin 14 and 11 -> Connected to Sub-immersive pump.

Pin Configuration- Beagle Bone Black



Beagle Bone Black Pin	Connected To	Description
P9_01	Moisture Sensor Analog pin	Receives analog values from moisture sensor
P9_21 (GPIO_03)	PWM L293D	To Control speed of the pump
P9_48 (GPIO_15)	Pin15 of L293D	Input 4 to the pump
P9_51 (GPIO_16)	Pin10 of L293D	Input 3 to the pump
P9_08	L293D Vcc	5V supply
P9_32	Soil sensor Vdd	Supply to moisture sensor

Working

The analog values from soil moisture sensor is read continuously. The moisture level ranges from 4 to 4500. We have defined the threshold of 250, which represents the soil is dry. If the value read form the sensor is less than 250, then the water pump is turned on. The water pump pumps the water for certain time until the moisture level goes beyond 250. The pump is turned off once the moisture level reaches the threshold.

Testing

Testing Process and Setup

The setup is tested by placing the soil moisture sensor in a un-watered plant. Initially the moisture level is very low which is 25, lower than threshold value of 250.

The pump is turned ON and starts watering the plant.
Once the moisture level reaches the threshold or beyond, the watering action stops.

Testing- Test Results

```
Moisture Level : 24
turning on 3
turning on 48
Moisture Level : 24
turning on 3
turning on 48
Moisture Level : 25
turning on 3
turning on 48
Moisture Level : 24
turning on 3
turning on 48
Moisture Level : 28
turning on 3
turning on 48
Moisture Level : 24
turning on 3
turning on 48
Moisture Level : 26
turning on 3
turning on 48
Moisture Level : 24
turning on 3
turning on 48
Moisture Level : 1229
Moisture Level : 1304
Moisture Level : 1206
Moisture Level : 1109
Moisture Level : 1078
Moisture Level : 1069
Moisture Level : 1066
Moisture Level : 1070
Moisture Level : 1082
Moisture Level : 1094
Moisture Level : 1114
```

IoT Stream

DEMO

Source Code: https://github.com/Achudan/CS695_PlantWatering/blob/main/moisture.c

Planned vs Actual Accomplishments

Planned

- Moisture Monitoring- Collect the moisture data for plant and store them.
- Website For Monitoring and Control- A web dashboard, where the streamed data are displayed in table and charts.
- Full Autonomous Mode- Mode where the pump turns ON and OFF automatically based on the sensor values.
- Semi-Autonomous Mode- Mode where user can provide inputs to sensor from internet.

Planned vs Actual Accomplishments

Accomplishments

- Moisture Monitoring- Collected stream of data from the moisture sensor and sent as message through MQTT MQ messaging services.
- Website For Monitoring and Control- A HTML web UI is created which displays data in a pictorial representation.
- Full Autonomous Mode- Mode where the pump turns ON and OFF automatically based on the sensor values.

Lessons Learnt

- How to read Analog inputs in beagle bone and their folder tree structure.
- How to use threads and deal with sensors concurrently.
- Integration of Actuators.
- Dealing with Motors and H-bridge driver was initially confusing. Later read through the circuit diagram and pin configuration of L293D motor driver. This helped in figuring out the result.
- How to stream data from beagle bone to an external server using messaging services.