

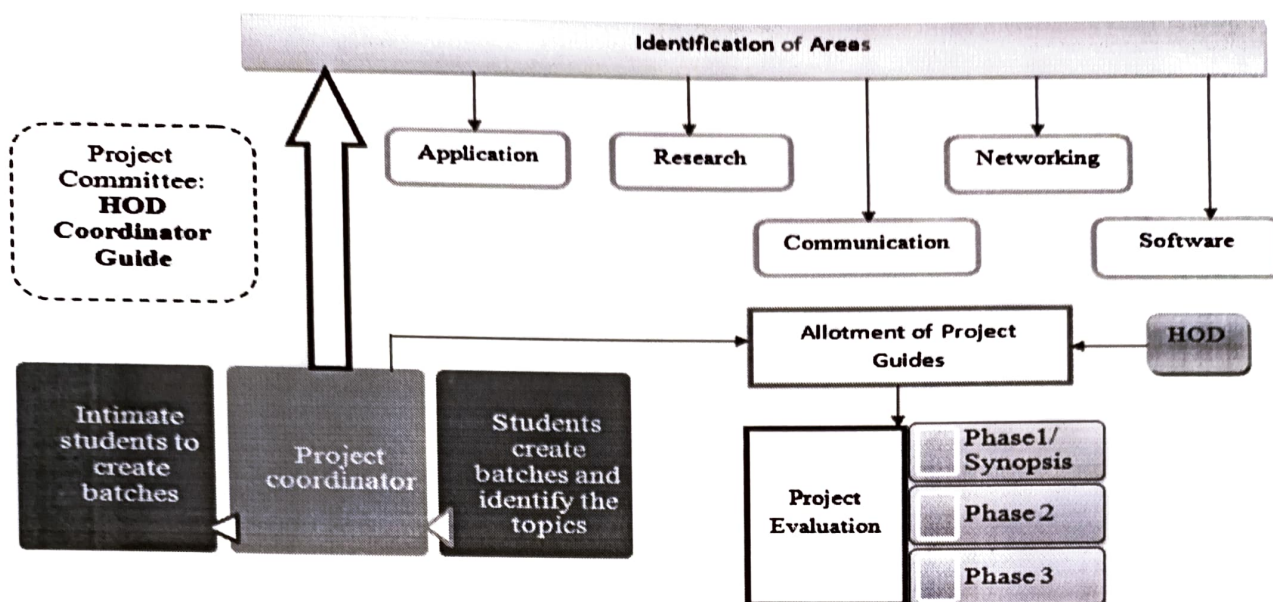
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**BGS Institute of Technology**  
BG Nagara – 571448  
**Department of Electronics and Communication Engineering**

**Process for Identification of projects and allocation methods**

**2018-19**

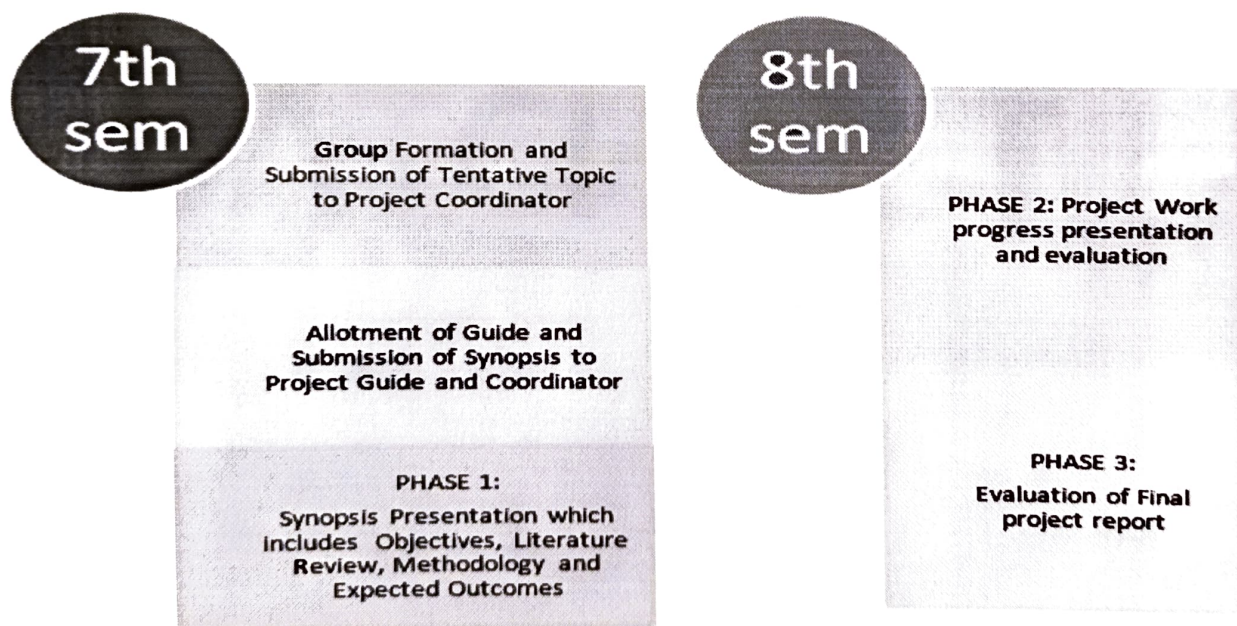
The Project coordinator is nominated by the head of the department, which plays a vital role in identification of projects and allocation methodology for faculty and students. The process is as follows as shown in figure 1.

- The students are instructed to do the project based on their interest.
- The students are allowed to form group/batch consisting of 2 to 4 members as per the university norms.
- Projects list of previous years are displayed on notice board to avoid duplication of projects.
- Students are informed to submit the proposed project title to project coordinator.
- Once the project is submitted the project coordinator with the help of HOD identifies the project based on areas like application, research, communication, networking and software.
- Allotments of project guides are made by the HOD and the project coordinators based on the students interest, Project Domain and the faculty specialization.
- Evaluation of project work is done in three phase according to the rubrics.
- Based on the evaluation of different phases final marks will be awarded to the students.
- The project committee consists of HOD, guide and project coordinator.



**Figure 1: Process to Identification of projects**

Monitoring the quality of student project is measured according to the process followed as shown in the figure 2.



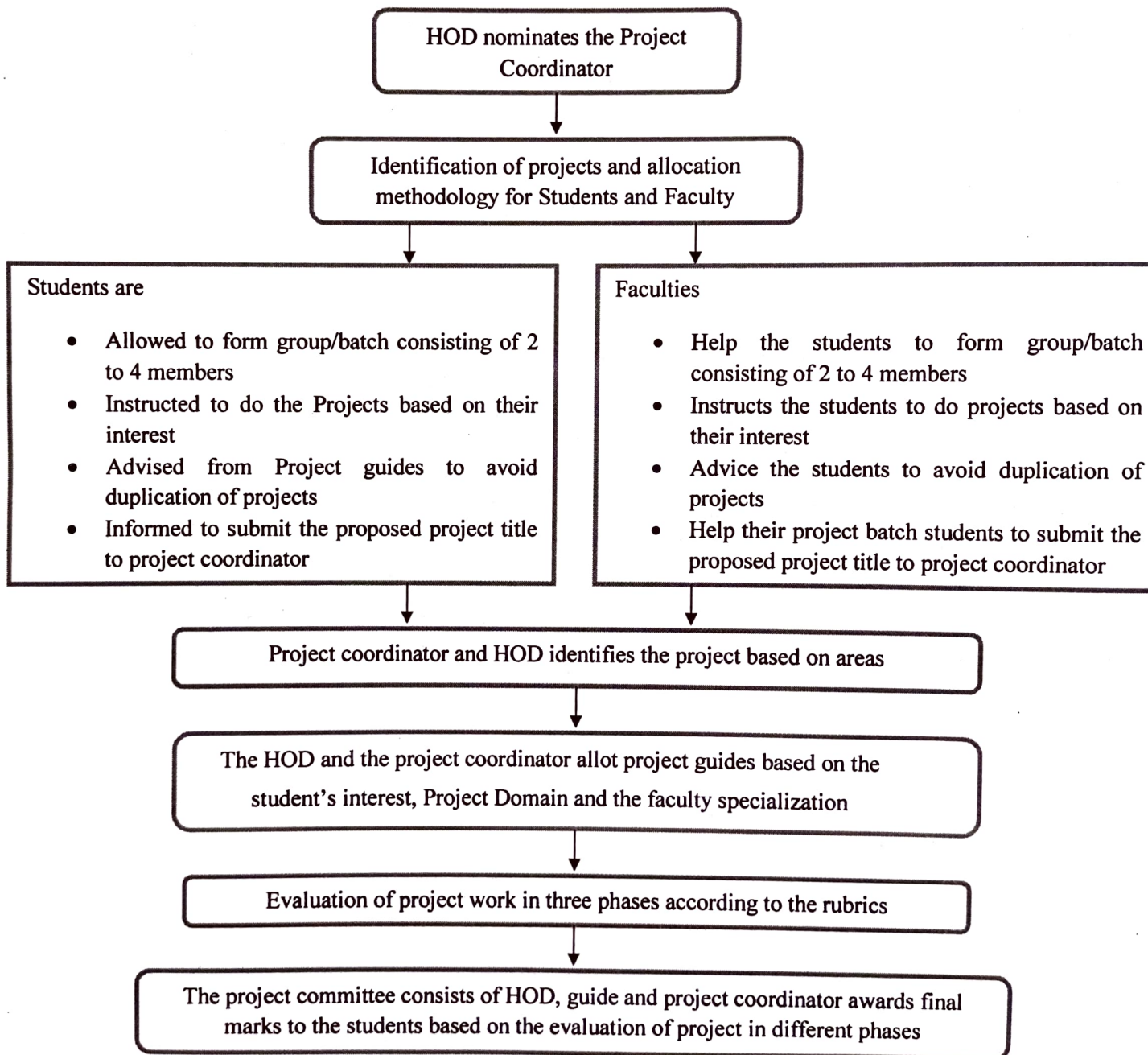
**Figure 2: Process to monitor Quality of student projects**

*[Signature]*  
Signature of Project Coordinator

*[Signature]*  
Signature of HOD  
Professor & HOD  
Dept. of Electronics & Communication Engg.,  
BGS Institute of Technology  
BG Nagara - 571 448  
Mandya District

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**Department of Electronics and Communication Engineering**

**Project Process flow chart**



  
**Signature of Project Coordinator**

  
**Signature of HOD**



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**Dept. of Electronics and Communication Engg.,**

**Process for Monitoring and Evaluation for the year 2018-19**

**I. Continuous Monitoring**

Project coordinator constituted by the HOD is accountable for planning, scheduling and execution of all the activities related to the student project work. Seminar is also planned by the respective coordinator. The process for continuous monitoring is shown in table 1.

**Table 1: Continuous Monitoring and Implementation of the project**

Timeline	Task	Particulars
<b>7<sup>th</sup> Semester</b>		
<b>September</b>	<b>Call for Project batch Formation and Guide allotment</b>	<ul style="list-style-type: none"> <li>Students are informed to Create their batch and get it registered with the project coordinator</li> <li>The Proposed synopsis is submitted by the students and gets verified by the project coordinator constituted by HOD.</li> <li>Allotment of Guide is done based on student interest, Project Domain and faculty specialization.</li> </ul>
<b>November</b>	<b>Synopsis Submission &amp; Phase 1 presentation</b>	<ul style="list-style-type: none"> <li>The phase 1 presentation is carried out and evaluated according to the rubrics.</li> <li>Final Synopsis is Submitted to Project coordinator</li> </ul>
<b>8<sup>th</sup> Semester</b>		
<b>March</b>	<b>Phase 2 Presentation</b>	<ul style="list-style-type: none"> <li>Students are instructed to submit objectives implementation, Design document, and interim results of the project.</li> <li>Students need to give a PowerPoint presentation For the phase 2. This is evaluated by the guide and faculty according to the rubrics.</li> </ul>
<b>April</b>	<b>Phase 3 Presentation</b>	<ul style="list-style-type: none"> <li>Students are instructed to submit complete project report with university fulfillment and give a PowerPoint presentation for the project including Demo of the model developed for evaluation.</li> </ul>
<b>May</b>	<b>Project Internal Marks Announcement</b>	<ul style="list-style-type: none"> <li>The evaluation marks for the project work is announced and processed according to the university regulations.</li> </ul>



## II. Project Evaluation

Internal project evaluation is done based on the different phases as per the university norms. The final project evaluation marks considered by taking the sum of phase-2 & phase-3 evaluation marks. The detailed marks distributions for different phases1, Phase2 and Phase 3 are shown in below table 2 (a), 2 (b) and 2 (c).

**Table 2 (a): Phase-1 of the Project**

Sl. No.	Evaluation scheme	Marks
1.	Significance and Relevance of work	15
2.	Problem Identification and Definition	10
3.	Presentation and Planning	50
4.	Synopsis Report	25
Total		100

**Table 2 (b): Phase-2 of the Project**

Sl. No.	Evaluation scheme	Marks
1.	PPT flow and Presentation	15
2.	Progress of Work	10
3.	Plan Execution	15
Total		40

**Table 2 (c): Phase-3 of the Project**

Sl. No.	Evaluation scheme	Marks
1.	PPT flow and Presentation	20
2.	Objective Implementation	20
3.	Results and Conclusion	10
4.	Report	10
Total		60

  
Signature of Project Coordinator

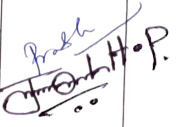
  
Signature of HOD  
Professor & HOD  
Dept. of Electronics & Communication Engg.  
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BG Nagara - 571 443  
Mandya District

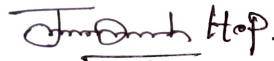
[JAI SRI GURUDEV]  
**BGS Institute of Technology**  
 BG Nagara, Nagamangala Taluk, Mandya District  
**Dept. of Electronics and communication Engineering**

Date: 30/11/2018


Subject: Project Work Phase-I+ Project Work Seminar  
 Subject Code: 15ECP78

**SYNOPSIS PRESENTATION**

Sl. No.	Project Title	USN	Name	Guide Details	Components / Criteria of Evaluation				Total (100)	Sign
					1	2	3	4		
1	IoT Based Intelligent forming case study on Strawberry	4BW16EC401	Amulya B R	Mr. Jayanth Dwijesh H P	12	08	48	16	84	
		4BW16EC410	Kavya H J		13	07	48	16	84	
		4BW15EC050	Madhushree D V		14	08	48	16	84	
		4BW16EC418	Mamatha K		14	08	47	15	84.	
2										

  
 Project Guide

  
 Project Coordinator

  
 HOD


1	Significance and Relevance of work	15 Marks	3	Presentation and Planning	50 Marks
2	Problem Identification and Definition	10 Marks	4	Synopsis Report	25 Marks


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 BG Nagara, Nagamangala Taluk, Mandya District  
**Dept. of Electronics and communication Engineering**

Date: 22/03/2019


Sub: Project Work Code: 15ECP85

SEMESTER END EVALUATION- PHASE 2

Sl. No.	Project Title	USN	Name	Guide Details	Components / Criteria of Evaluation			Total (40)	Sign
					1	2	3		
1	IoT Based Intelligent forming case study on Strawberry	4BW16EC401	Amulya B R	Mr. Jayanth Dwijesh H P	14	09	15	38	
		4BW16EC410	Kavya H J		14	09	15	38	
		4BW15EC050	Madhushree D V		14	09	15	38	
		4BW16EC418	Mamatha K		14	09	15	38	
2									

  
 Project Guide

  
 Project Coordinator

  
 HOD

1	PPT flow and Presentation	15 Marks	2	Progress of work	10 Marks	3	Plan execution	15 Marks
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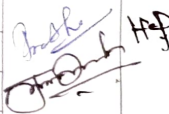
||JAISRI GURUDEV||  
**BGS Institute of Technology**  
 BG Nagara, Nagamangala Taluk, Mandya District  
**Dept. of Electronics and communication Engineering**

Date: 03/05/2019

Subject: PROJECT WORK


Subject Code: 15ECP85

**SEMESTER END EVALUATION-PHASE 3**

Sl. No.	Project Title	USN	Name	Guide Details	Components / Criteria of Evaluation				Total (60)	Sign
					1	2	3	4		
1	IoT Based Intelligent forming case study on Strawberry	4BW16EC401	Amulya B R	Mr. Jayanth Dwijesh H P	19	20	10	10	59	
		4BW16EC410	Kavya H J		19	20	10	10	59	
		4BW15EC050	Madhushree D V		19	20	10	10	59	
		4BW16EC418	Mamatha K		19	20	10	10	59	
2										

  
 Project Guide

  
 Project Coordinator

  
 HOD


1	PPT flow and Presentation	20 Marks	3	Results and Conclusion	10 Marks
2	Objective Implementation	20 Marks	4	Report & Publications	10 Marks


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 BG Nagara, Nagamangala Taluk, Mandya District  
**Dept. of Electronics and communication Engineering**

Subject: Project Work

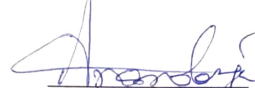
Subject code: 15ECP85

**SEMESTER END EVALUATION**

Sl. No.	Project Title	USN	Name	Guide Details	PHASE 2	PHASE 3	Total	Sign
					(40)	(60)	(100)	
1	IoT Based Intelligent forming case study on Strawberry	4BW16EC401	Amulya B R	Mr. Jayanth Dwijesh H P	38	59	97	
		4BW16EC410	Kavya H J		38	59	97	
		4BW15EC050	Madhushree D V		38	59	97	
		4BW16EC418	Mamatha K		38	59	97	
2								

  
 Project Guide

  
 Project Coordinator

  
 HOD



# **VISVESVARAYA TECHNOLOGICAL UNIVERSITY**

**"Jnana Sangama", Belgaum 590 014, Karnataka, India**



**A PROJECT REPORT ON**

## **"IOT BASED INTELLIGENT FORMING CASE STUDY ON STRAWBERRY"**

**Submitted in partial fulfilment of the requirements for the award of the  
degree of**

**BACHELOR OF ENGINEERING  
IN  
ELECTRONICS AND COMMUNICATION ENGINEERING  
For The Academic Year 2018-2019**

**Submitted By**

<b>AMULYA B R</b>	<b>4BW16EC401</b>
<b>KAVYA H J</b>	<b>4BW16EC410</b>
<b>MADHUSHREE D V</b>	<b>4BW15EC050</b>
<b>MAMATHA K</b>	<b>4BW16EC418</b>

**Under the Guidance of  
Mr. JAYANTHDWIJESH H P BE, M.tech  
Assistant Professor, Dept. of ECE, BGSIT**



**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING  
B.G.S INSITUTE OF TECHNOLOGY  
BG Nagar, Nagamangala Taluk, Mandya District 571448  
2018-2019**



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<b>MAMATHA K</b>	<b>4BW16EC418</b>

**Under the Guidance of**

**Mr. JAYANTHDWIJESH H P BE, M.tech**

**Assistant Professor, Dept. of ECE, BGSIT**



**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**B.G.S INSITUTE OF TECHNOLOGY  
BG Nagar, Nagamangala Taluk, Mandya District– 571448  
2018–2019**



# BGS INSTITUTE OF TECHNOLOGY

B G Nagar, Nagamangala Taluk, Mandya District – 571448

Affiliated to Visvesvaraya Technological University

## DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING



### CERTIFICATE

This is to certify that the project work entitled “**IOT BASED INTELLIGENT FARMING CASE STUDY ON STRAWBERRY**” is a bonafide work carried out by **AMULYA B R** (4BW16EC401), **KAVYA H J** (4BW16EC410), **MADHUSHREE D V** (4BW15EC050), **MAMATHA K** (4BW16EC418) in partial fulfillment for the award of Bachelor of Engineering in **ELECTRONICS AND COMMUNICATION ENGINEERING** of the **VISVESVARAYA TECHNOLOGICAL UNIVERSITY**, Belgavi during the year 2018-2019. It is certified that all corrections/suggestions indicated for the internal assessment have been incorporated in the report deposited in the department library. The Project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

Signature of the Guide  
**Mr. JAYANTHDWIJESH H P**  
Asst. Prof, Dept. of ECE  
BGSIT

Signature of the HOD  
**Dr. ANANDARAJU M B**  
Prof & HOD of ECE  
BGSIT

Signature of the Principal  
**Dr. NARENDRA B K**  
Principal of BGSIT

### External Viva

#### Name of Examiners

1. **Manoj Kumar SS**
2. **Lakshwari H.S.**

#### Signature of Examiners

  
13/6/2019  
  
13/6/19



## DECLARATION



We Amulya B R, Kavya H J, Madhushree D V, Mamatha K a student's of final year Bachelor of Engineering, Department of ECE, B G S Institute of Technology, B G Nagar, Nagamangala TQ, Mandya Dist. hereby declare that the project work entitled **"IOT BASED INTELLIGENT FARMING CASE STUDY ON STRAWBERRY"** submitted to the **VISVESVARAYA TECHNOLOGICAL UNIVERSITY, Belagavi** during the academic year **2018-2019**, is a record of an original work done us under the guidance of **Mr. JAYANTHDWIJESH H P**, Asst Professor, Dept of ECE, B.G.S Institute of Technology. This project work is submitted in partial fulfillment of the requirements for the award of **BACHELOR OF ENGINEERING IN ELECTRONICS AND COMMUNICATION**, I Further declare that work embodied in this project report have not been submitted by to any other university or institution for the award of any degree.

DATE: \_\_\_\_\_

AMULYA B R

PLACE: BG Nagara, Nagamangala TQ, Mandya Dist

KAVYA H J

MADHUSHREE D V

MAMATHA K



## ACKNOWLEDGEMENT

The satisfaction and euphoria that accompanies the successful completion of any task would be incomplete without the mention of the people who made it possible. Many are responsible for the knowledge and experience we have gained during my project work and throughout the course

It gives me a great pleasure in expressing my deepest sincere thoughts of gratitude to our college founder Jagadguru Sri Sri Sri **Dr. Balagangadharanatha Mahaswamiji**.

I also express my humble pranams to his holiness Sri Sri Sri **Dr. Nirmalanandanatha Mahaswamiji**.

I wish to express my sincere gratitude to our beloved principal **Dr. B.K Narendra**, BGSIT, B.G Nagar, Mandya for extending his full support and co-operation by allowing me to do the project in the establishment.

I thank **Dr. M.B Anandaraju**, Professor & HOD, Department of Electronics and communication, BGSIT, B.G. Nagar, Mandya for permitting me to conduct my project and for extending his full support and co-operation.

I thank **Mr. H.P Jayanth Dwijesh**, Assistant Professor, Department of Electronics and communication, BGSIT, B.G. Nagar, Mandya for providing me with enough technical guidance and all the support needed throughout the course of my project work can never forget his valuable guidance and timely suggestion given to me..

I feel it is my duty to acknowledge the help rendered to me by various persons. We consider it is my privilege to place on record my heart full gratitude for my project guide.

Lastly, I this opportunity to extend my full hearted thanks, gratitude and respect to my **Parents, Lecturers**, and all my Friends, for giving me valuable advices and support at all times in all possible ways.

**AMULYA B R**  
**KAVYA H J**  
**MADHUSHREE D V**  
**MAMATHA K**



## ABSTRACT

The use of innovative tools based on digital technologies in farming is expected to bring a number of benefits, such as increased productivity, increased profitability, and reduced environmental footprint, just to name a few. The use of digital technologies facilitating a higher productivity is recommended by the Food and Agricultural Organization of the UN (FAO), as the associated increase in productivity can help reduce the food security risk faced in some regions of the world. If we focus on the Indian case, where food security is a major concern, digital technologies have the potential of helping Indian farmers face other important challenges that are more specific to nation, such as profitability, environmental footprint and sustainability of their exploitations and businesses.

By smart farming we understand the application of data gathering (edge intelligence), data processing, data analysis, Smart Irrigation and automation technologies on the overall value chain, that jointly orchestrated allow operation and management improvement (analytics) of a farm with respect to standard operations (near real time) and re-use of these data (animal-plant-soil) in improved chain transparency (food safety) and chain optimization (smart data). Such capabilities will be necessarily supported by Internet of Things (IoT) technologies using Raspberry Pi with web based smart App.

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## **CHAPTER - 1**

### **INTRODUCTION**

From the farmer's point of view, smart farming should provide the farmer with added value in the form of better decision making or more efficient exploitation operations and management. In this sense, smart farming is strongly related, but not limited, to the concepts of Precision Agriculture and Precision Livestock Farming. Farming modalities may include the production of vegetables, cattle (including dairy production) and others. Smart farming applications do not target only large, conventional farming exploitations, but could also be new levers to boost other common or growing trends in agricultural exploitations, such as family farming (small or complex spaces, specific cultures and/or cattle, preservation of high quality or peculiar varieties,...), organic farming, and enhance a very respectful and transparent farming accordingly to European consumer, society and market consciousness. Smart farming can also provide great benefits in terms of environmental issues, for example, through more efficient use of water, or optimisation of treatments.

The term food safety refers to the awareness, prevention and risk-based measures of foodborne illnesses, from food production to consumption. Consumers' demands are currently the main drivers encouraging food industries to produce healthier and safe food products that being at their highest possible quality specifications. The challenge is that transparency of food safety should become data-driven and near realtime so that new applications and chain cooperation can lead to a more dynamic and responsive food production network. This terminology includes: - "Food loss", which refers to food that spills, spoils, incurs an abnormal reduction in quality such as bruising or wilting, or otherwise gets lost before reaching the consumer. Food loss typically occurs at the production, storage, processing and distribution stages of the food value chain, and is the unintended result of agricultural processes or technical limitations in storage, infrastructure, packaging and/or marketing. "Food waste", which refers to food that is of good quality and fit for consumption, but does not get consumed because it is discarded – either before or after it spoils. Food waste typically, but not exclusively, occurs at the retail and consumption stages in the food value chain, and is the result of negligence or a conscious decision to throw food away.

## **CHAPTER – 2**

### **OBJECTIVE AND PROBLEM STATE**

#### **Objective:**

To build a IOT based Intelligent Farming using Raspberry Pi with farmer friendly multipurpose Web App. Iot based smart farming aims at providing sensor based smart irrigation system, Phase detection and turning on and OFF the motor automatically, sending the status to farmer using IoT technology, providing a farmer to interact with markets with Web App so as to avoid mid man interferences and ultimately to increase the yield with maintaining food quality.

#### **Problem state:**

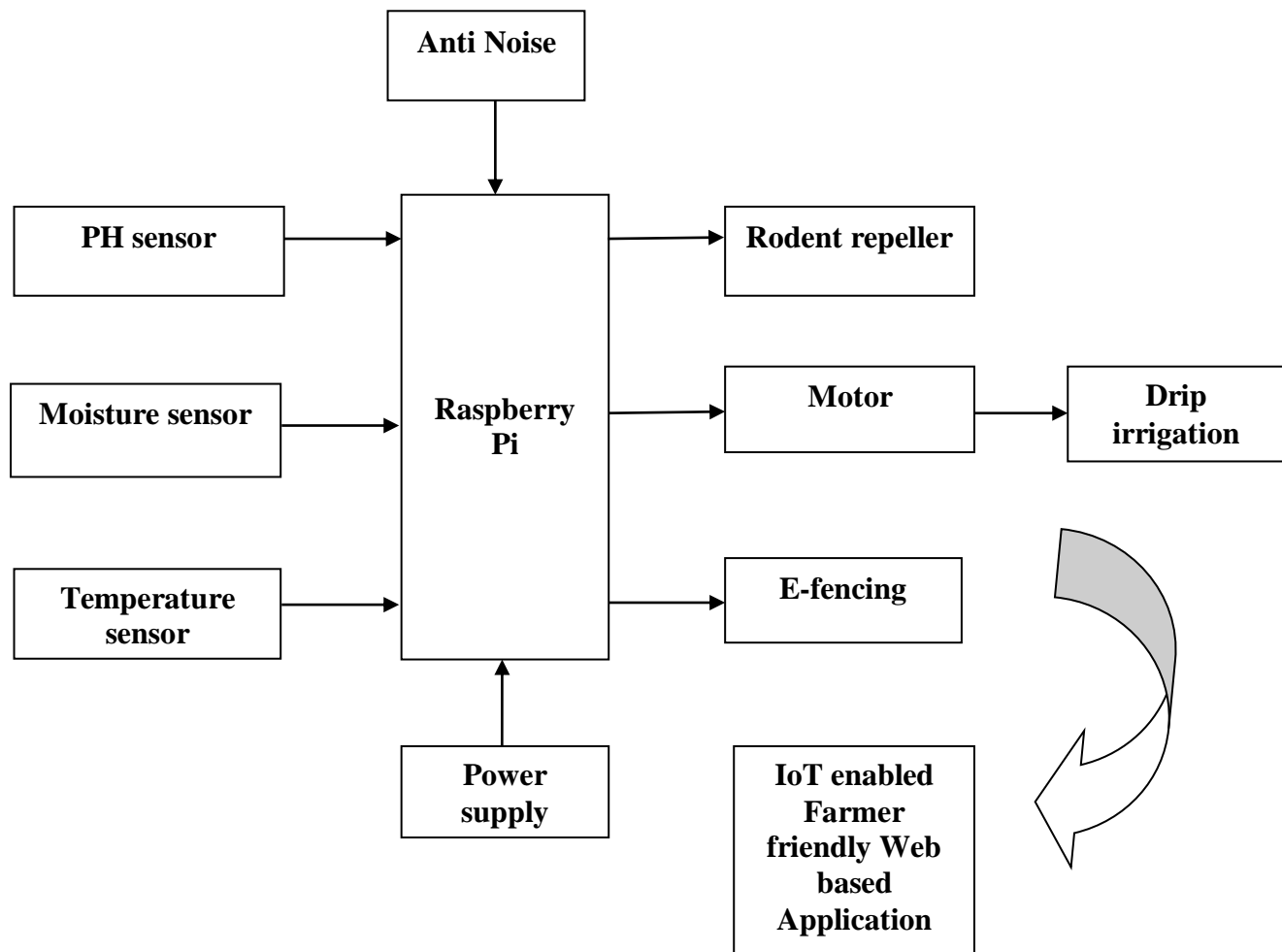
This paper presents security of internet of things. In the internet of things vision, every physical object has a virtual component that can produce and consume services.



## **CHAPTER – 3**

### **OVER VIEW OF THE PROJECT: BLOCK DIAGRAM**

The greenhouse works best when the temperature is not too hot and not too cold. Though it sounds simple in the spring and autumn we can easily have a wide range of temperatures from the cold in the middle of the night to the excessive heat of the day when the sun is shining. During the day the rays from the sun penetrate the greenhouse and warm up and light up the surroundings. Light escapes through the glass walls but the heat in form of infra-red radiations gets trapped inside the green house leading to an incubating effect and the temperature inside gradually increases. This increased temperature leads to an increase in the rate of transpiration which is harmful to the plants.



**Fig 3.1: Block diagram of the system**

### **3.1 WORKING OF THE SYSTEM**

Basically the project is basically having two units. One is the agricultural land having Advanced processor Raspberry Pi interfaced with different sensors like soil moisture sensor for measuring the water content in the soil, a phase detector circuit for analyzing the three phase availability, a motor and valve for supplying the water on demand, an electronic fencing to avoid animals entering inside an agricultural land and IoT for linking the information of the farm to farmer.

Another is the web based IoT enabled smart farmer friendly app with which farmer can control his agricultural land any time and even he can access any data at any time sitting at one place. The web app not only limited for controlling and accessing the data regarding farm but also allows the farmer to get connected with the world of farmers market so that he can get any information like market price of the crops, the best technologies to improvise the yield, the best fertilizers available, how to avoid middle man and so on. Also he can market his product or yield online. The system allows automatic irrigation system with phase detection system to provide better yields.

Wireless sensor networks sense accurately the needed water quantity and supply precisely allowing saving the water. The phase detection allows switching on and off the motor automatically whenever there is three phase power. E fencing prevents the animals entering inside land. Everything is interfaced so accurately with the invention of advanced Embedded Technology. Advanced Raspberry pie is enabled with IOT vehicles data base can be created and it can be linked to the server using an app installed in any laptop. It gives a flexible front end for farmer authorities to have a complete update of the farming, market info and so on. Market people can also get in touch with farmers using web based application

#### **3.1.1 PH sensor**

Agar plates, skin, and electrophoresis gels are all surfaces that may be difficult to measure with a typical glass bulb electrode due to concerns about bulb breakage. To facilitate these and other surface measurements, we created the pH2100 flat tip pH electrode. It has a rugged flat measurement surface, which breaks less easily when it comes in contact with hard materials. This makes it a great choice for measuring slurries, sledges, and viscous samples as well as those containing suspended solids.



- Flat measurement tip for surface measurements and slurries.
- Double junction electrode design prevents reference contamination.
- Booted BNC protects meter connection.
- One year limited warranty.



**Fig 3.2: PH Sensor**

- Soil Tester Moisture - Light - PH
- 3 in 1 multifunctional moisture, PH and light meter
- No battery required, simple and convenient to use
- Simply insert probe of the meter into the soil, switch to the setting you want to measure and read the scale.
- Probe length:21cm
- How to Use for Project Purpose ( U need to open Backside while opening take , it shld not damage Meter , then solder across meter You will get Analog O/p - 0.2volts - 0.9 volts

### 3.1.2 Soil moisture sensor

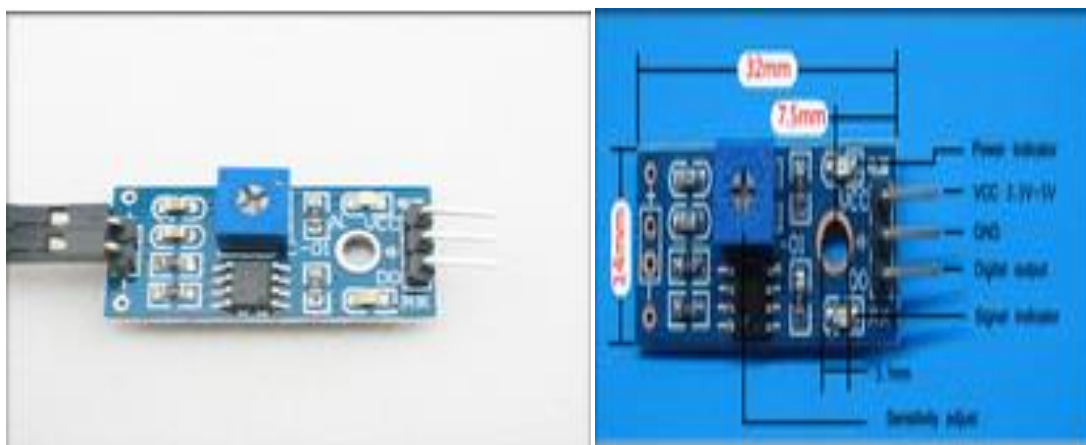
Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. This Soil Moisture Sensor can be used to detect the moisture of soil or judge if there is water around the sensor, let the plants in your garden reach out for human help.

Insert this module into the soil and then adjust the on-board potentiometer to adjust the sensitivity. This sensor can be used to test the moisture of soil, when the soil is having water shortage, the module output is at high level, else the output is at low level. By using this sensor one can automatically water the flower plant, or any other plants requiring automatic watering technique. Module triple output mode, digital output is simple, analog output more accurate, serial output with exact readings.



**Fig 3.3: Soil moisture sensor**

The sensor would outputs logic HIGH/LOW when the moisture is higher/lower than the threshold set by the potentiometer. With help of this sensor, it will be realizable to make the plant remind you: Hey, I am thirsty now, please give me some water.



**Fig3.4: circuit diagram**



Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a Frequency domain sensor such as a capacitance sensor. Another sensor, the neutron moisture gauge, utilize the moderator properties of water for neutrons. Soil moisture content may be determined via its effect on dielectric constant by measuring the capacitance between two electrodes implanted in the soil. Where soil moisture is predominantly in the form of free water (e.g., in sandy soils), the dielectric constant is directly proportional to the moisture content. The probe is normally given a frequency excitation to permit measurement of the dielectric constant. The readout from the probe is not linear with water content and is influenced by soil type and soil temperature. Therefore, careful calibration is required and long-term stability of the calibration is questionable.

- In This sensor we are using 2 Probes to be dipped into the Soil.
- As per Moisture We will get Analog Output variations from 0.60volts - 5volts.
- Input Voltage 5V DC.

### **Application Idea**

- Botanical gardening
- Water monitoring
- Agriculture
- Landscape irrigation

### **Features**

- Digital output, easy to adjust
- Nickel plating to avoid corrosion
- Working voltage: 3.3V-5V
- On-board LM393 chip
- Dimension of the board: 3.2cm \* 1.4cm
- Sensitivity adjustable.
- Has fixed bolt hole, convenient installation.
- Threshold level can be configured.
- Module triple output mode, digital output is simple, analog output more accurate, serial output with exact readings.

**Functional description of Soil moisture sensor:**

The two copper leads act as the sensor probes. They are immersed into the specimen soil whose moisture content is under test. The soil is examined under three conditions:

**Dry condition:** The probes are placed in the soil under dry conditions and are inserted up to a fair depth of the soil. As there is no conduction path between the two copper leads the sensor circuit remains open. The voltage output of the emitter in this case ranges from 0 to 0.5V.

**Optimum condition:** When water is added to the soil, it percolates through the successive layers of it and spreads across the layers of soil due to capillary force. This water increases the moisture content of the soil. This leads to an increase in its conductivity which forms a conductive path between the two sensor probes leading to a close path for the current flowing from the supply to the transistor through the sensor probes. The voltage output of the circuit taken at the emitter of the transistor in the optimum case ranges from 1.9 to 3.4V approximately.

**Excess water condition:** With the increase in water content beyond the optimum level, the conductivity of the soil increases drastically and a steady conduction path is established between the two sensor leads and the voltage output from the sensor increases no further beyond a certain limit. The maximum possible value for it is not more than 4.2V.

**Using the Sensor**

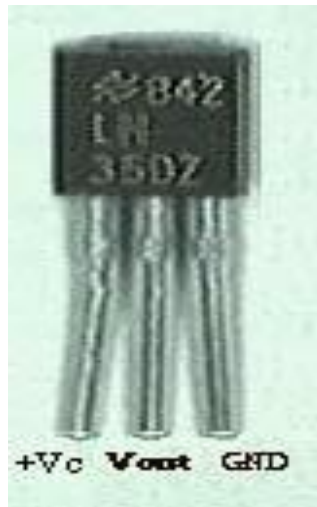
- Connect +5v to pin 2 and ground to pin 5 and 6.
- Pin 4 and 5 should be connected to particular transmitter and receiver pin of controller.
- Output pin may be connected to any port pins and can be used to any application.

**3.1.3 Temperature sensors**

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.



The LM35 does not require any external Calibration or trimming to provide typical accuracies of  $\pm 1/4^\circ\text{C}$  at room temperature and  $\pm 3/4^\circ\text{C}$  over a full  $-55^\circ\text{C}$  to  $+150^\circ\text{C}$  temperature range. Low cost is assured by trimming and calibration at the wafer level.



**Fig 3.5: LM35 Temperature sensor**

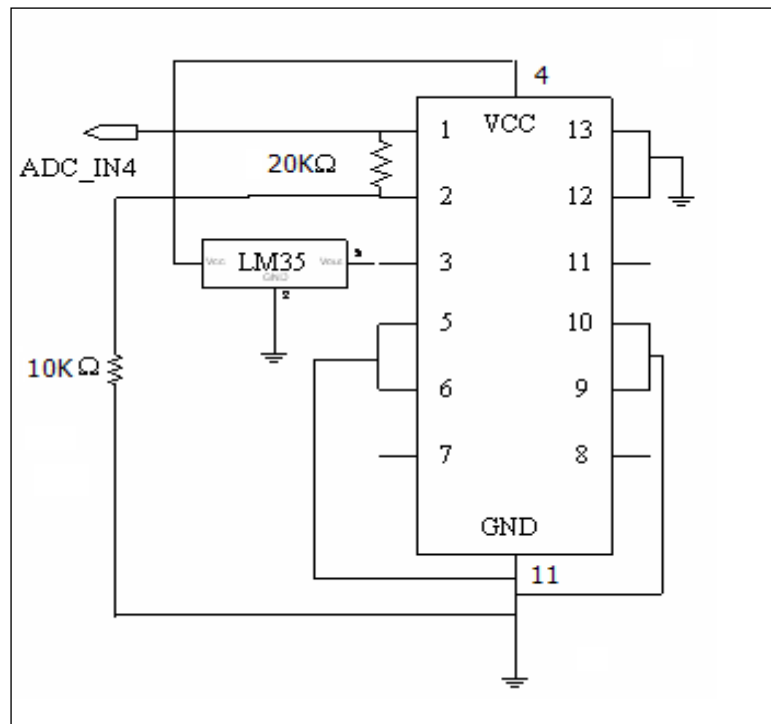
The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 mA from its supply, it has very low self-heating, less than  $0.1^\circ\text{C}$  in still air. The LM35C is rated operate over a  $-55^\circ\text{C}$  to  $+150^\circ\text{C}$  temperature range, while the LM35D is rated for a  $-40^\circ\text{C}$  to  $+110^\circ\text{C}$  range ( $\pm 10^\circ\text{C}$  with improved accuracy).

The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-202 package.

### Features

- Calibrated directly in  $^\circ\text{C}$  (Centigrade)
- Linear  $\pm 10.0\text{ mV}/^\circ\text{C}$  scale factor
- $0.5^\circ\text{C}$  accuracy guaranteeable (at  $\pm 25^\circ\text{C}$ )
- Rated for full  $-55^\circ\text{C}$  to  $+150^\circ\text{C}$  range
- Suitable for remote applications
- Low cost due to wafer-level trimming

- Operates from 4 to 30 volts
- Less than 60 mA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only  $\pm 1/^\circ\text{C}$  typical
- Low impedance output, 0.1 X for 1 mA load



**Fig 3.6: Temperature sensor circuit**

### Functional description

- The sensor has a sensitivity of 10mV /  $^\circ\text{C}$ .
- The output of LM35 is amplified using a LM324 single power supply (+5V) op-amp.
- The op-amp is designed to have a gain of 5.
- The circuitry measures temperatures with a resolution of up to 0.5 degree Celsius.
- The output voltage varies linearly with temperature.

### 3.1.4 Power supply connection

The power supply section consists of step down transformers of 230V primary to 9V and 12V secondary voltages for the +5V and +12V power supplies respectively. The



stepped down voltage is then rectified by 4 1N4007 diodes. The high value of capacitor 1000  $\mu$ F charges at a slow rate as the time constant is low, and once the capacitor charges there is no resistor for capacitor to discharge. This gives a constant value of DC. IC 7805 is used for regulated supply of +5 volts and IC 7812 is used to provide a regulated supply of +12 volts in order to prevent the circuit ahead from any fluctuations. The filter capacitors connected after this IC filters the high frequency spikes. These capacitors are connected in parallel with supply and common so that spikes filter to the common.

As can be seen from the above circuit diagrams, the rectified voltage from the 4 diodes is given to pin 1 of the respective regulators. Pin 2 of the regulators is connected to ground and pin 3 to  $V_{CC}$ . With adequate heat sinking the regulator can deliver 1A output current. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

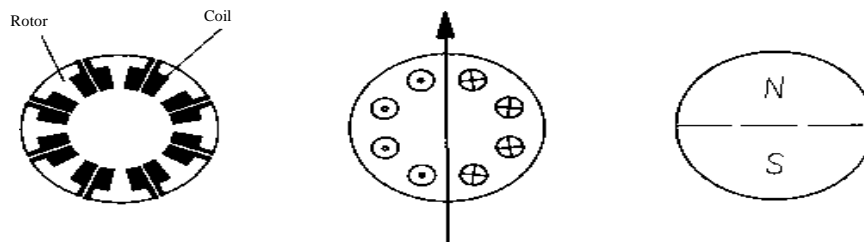
### **3.1.5 DC motor**

Many applications call for a high start-up torque. The D.C. motor, by its very nature, has a high torque vs. falling speed characteristic and this enables it to deal with high starting torques and to absorb sudden rises in load easily. The speed of the motor adjusts to the load. Furthermore, the D.C. motor is an ideal way of achieving the miniaturization designers are constantly seeking because the efficiency it gives is high compared with other designs. This motor follows linear laws of operation and because of this it is easier to fully exploit its characteristics compared to synchronous or asynchronous motors.

#### **Principle of operation**

Whatever the complexity of the rotor coil windings, once they are energized, they may be represented in the form of a ferromagnetic cylinder with a solenoid wrapped around it. The wire of the solenoid is in practice the wire bundle located in each groove of the rotor. The rotor, when energized, then acts as an electromagnet, the magnetic field following the axis separating the wires of the solenoid in the direction of the current which flows through them. The motor, therefore, consists of fixed permanent magnets (the stator) a moving magnet (the rotor) and a metal carcass to concentrate the flux (the motor body). As soon the rotor begins to turn, the fixed brushes make and break contact with the rotating commutator segments in turn. Soon the rotor begins to turn the fixed brushes make and break contact with the rotating commutator segments in turn.

The rotor coils are then energized and de-energized in such a way that as the rotor turns, the axis of a new pole of the rotor is always perpendicular to that of the stator. Because of the way the commutator is arranged, the rotor is in constant motion, no matter what its position. Fluctuation of the resultant torque is reduced by increasing the number of commutator segments, thereby giving smoother rotation.



**Fig 3.7: Rotor coils**

By the attraction of opposite poles and repulsion of like poles, a torque then acts on the rotor and makes it turn. This torque is at a maximum when the axis between the poles of the rotor is perpendicular to the axis of the poles of the stator. By reversing the power supply to the motor, the current in the rotor coils, and therefore the north and south poles, is reversed. The torque which acts on the rotor is thus reversed and the motor changes its direction of rotation. By its very nature, the D.C. motor is a motor with a reversible direction of rotation.

### **3.1.6 L293D Motor Driver**

For robots that need to be lean, mean, and effective, the Solarbotics ‘Secret’ L293D motor driver replaces the guts of standard servos with the power of the robot-friendly L293D motor driver chip. It fits right inside most standard servo bodies, to give your robot more power from a tighter space



**Fig 3.8: L293D Motor Driver**



### **3.2PART LIST**

- 1 - Suspiciously small red printed circuit board (PCB).
- 1 - L293D motor driver chip (the star of our show!).
- 2 - LEDs Light-emitting diodes. Cool, small ones.
- 1 - 1k current - limiting resistor (Brown / Black / Red / Gold).
- 1 - Length of 5 conductor ribbon cable.



**Fig 3.9: components of motor**

We strongly suggest you inventory the parts in your kit to make sure you have all the parts listed (c'mon - there's barely a handful of parts, so count them!). If anything is missing, contact Solarbotics Ltd. for replacement parts information.

#### **3.2.1 Disclaimer of Liability**

Solarbotics Ltd. is not responsible for any special, incidental, or consequential damages resulting from any breach of warranty, or under any legal theory, including lost profits, downtime, good-will, damage to or replacement of equipment or property, and any costs or recovering of any material or goods.

#### **3.2.2 Introduction**

One of the first realizations in robotics is that making something move isn't an easy task. You simply can't take a "brain" circuit and connect it to a motor and expect anything to happen. The motor will simply say "HAH!" at the puny output signal from the brains, and stay stationary. What the brain needs is an

enforcer. Muscles something to convince the motor to do things the way the brains want it to be done. There are many ways to strengthen ("buffer") a signal so it's strong enough to drive a large load like a motor. Transistor H- bridges circuit, buffer chips, and dedicated motor driving chips are all suitable candidates, with their own benefits and limitations. For our 'Secret' motor driver, we wanted something that would take standard TTL (well, CMOS too) inputs and make a standard servo our slave. You see, standard servos use a "Pulse Width Modulated" ("PWM") signal to tell a servo where to rotate to. PWM works by sending a rapid train of high/low signals to the servo's regular driver brains, and depending on how different the high signal is from the low signal, the servo moves to the according position.

PWM is great if you don't want to rotate much more than 180°, which is fine for actuators, but not for driving wheels. With our 'Secret' motor driver and a bit of servo hacking, we're going to lobotomize and turn a standard servo into something more useful - a small, compact, powerful gear motor! It'll be something you can use very simple input signals to control it's rotation. We'll even throw in a 5V regulator hack if you want to clamp the voltage right at the servo. Or, modify it for use on a breadboard, which will make good use of the driver's indicator LEDs to show direction of rotation. Ohm, it's time to get to work! (This'll be great...).

### Step 1: Installing the IC

The L293D is a 16-pin chip with a little notch cut out of the front of it (that last bit is for you non-experts). Orient the chip so its notch matches the notch in the shape of the chip on the PCB. Carefully drop the chip into the gold-plated (pretty uptown, eh?) pads, and solder it into place from the other side.

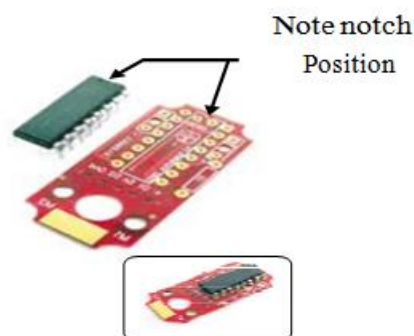
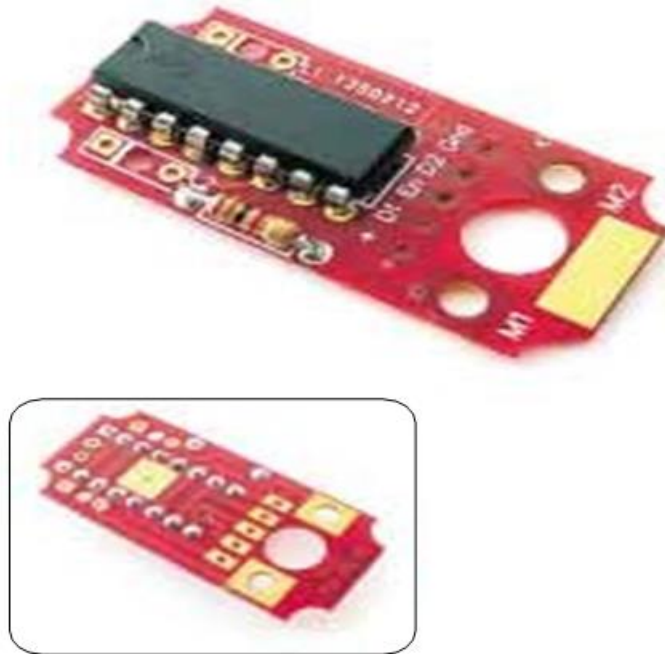


Fig3.10: installing IC

### **Step 2: The 1k Resistor**

The 1k resistor (brown / black/ red / gold) is inserted in about the only position it can fit into - position 'R1'. Snug it up close to the circuit board, bend the leads over, and solder it into place from the other side. When done, clip off the excess leads.



**Fig 3.11: installing resistor**

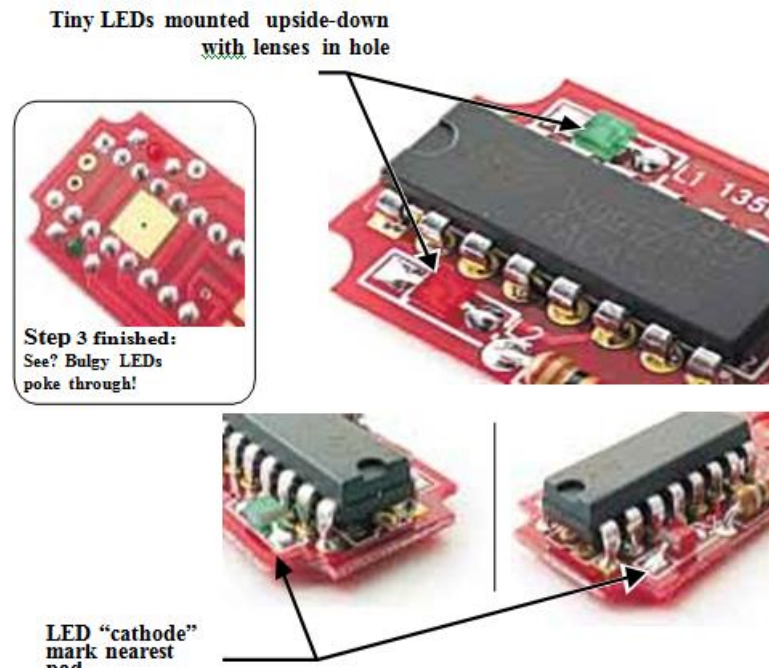
### **Step 3: LED Installation**

This is one of the really cool things about the 'secret' driver board - the LED indicators. You have the option to mount them upside-UP or upside-DOWN. We recommend upside-DOWN, so you can easily see them from either side.

The tiny LEDs in your kit have a lenses that can be poked into the hole of the PCB which can easily been seen if you use the driver board on a breadboard, or in a transparent servo case (like the Solarbotics GM4 motor). Don't worry - you'll still see the LED light up from the other side too!

**NOTE:** Upside-down or upside-up, just as long as the lead near the painted bar on the LED (the cathode) goes into the square pad hole, and matches the bar printed on the PCB! If they aren't installed properly, they aren't going to light up!





**Fig 3.12: LED installation**

#### **Step 4: Wiring & Installation**

Your kit comes with a set of five (5, for those who can't read "five") conductor ribbon cable. You'll have to split the ends apart, and strip off about 1.5mm (1/16") from each end.

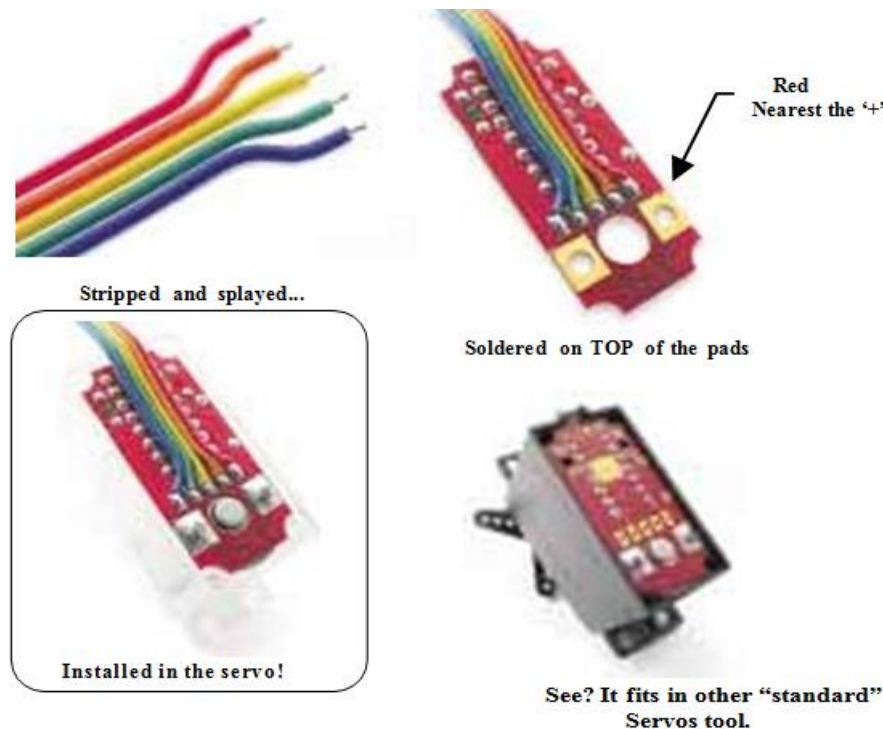
Try to arrange your ribbon cable like the one below, as splaying them apart will make it easier to solder each end to the driver board. For easier soldering, pre-tin the ends of each wire.

Starting with the **red wire** on the side nearest the pad marked '+', start soldering them into place, one per pad. We'll be using the wire colors for different functions.

**IMPORTANT:** If possible, solder the wires down on top of the pad - not through. The metal motor case underneath can (and will!) short out leads that poke through the PCB. If you have to use the holes, trim the excess lead off flush with the bottom of the PCB.

**If you want to use your motor driver on a breadboard, skip ahead to "Option 3".**

When done, drop the wired PCB into the servo, on top of the motor tabs. Solder the motor tabs to the PCB, and you're ready to close it up!



**Fig3.13: Wiring and Installation**

### **Step 5: Closing it up**

No rocket science here - simply put the servo bottom plate back in place, inserts the corner screws, and tighten them down. Be careful to fold over a few of the edge ribbon wires, as it'll be too wide to fit the slot that originally fit three. Or hey - be a rebel and use a knife (or other favorite tool of destruction) and widen the slot so all five wires lay flat.

### **Usage**

So you want to know how to use it? It isn't too difficult. Here's the long and short of it:

Red - Vcc ('+')

Blue - Gnd ('-') (on the opposite side of the cable)

Orange & Green - D1 & D2 (direction power flow of motor outputs)

Yellow - Enable (turns the chip off - connect to gnd to turn it off).

Connect the red ('+') and blue ('-') to power. Leave the yellow line alone, unless if you want to turn the chip off, or pulse it to slow the motor down (a technique called "Pulse Width Modulation). Connect D1 to 5V, D2 to gnd, and the motor will turn one way. Connect D1 to gnd, and D2 to 5V, and the motor turns



the other way. Connect D1 and D2 to either 5V or gnd, and the motor is in “brake” mode (try turning it - hard to do, eh?).

Connect the yellow line to gnd, and it doesn’t matter what D1 and D2 are connected to, as the motor is in “coast” mode, as if it weren’t connected to the motor driver board at all.



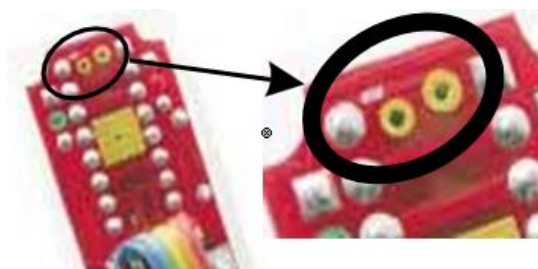
**Fig 3.14: Closing wires**

### **3.3 OPTION 1-5V IC LOGIC**

Although the SGS Thompson L293D can take logic *and* motor voltage of up to 36 volts, we don’t recommend running both beyond 12 volts. The Vcc line really only needs 5 volts to run the “brains” of the chip. Beyond that, you start consuming the valuable power-handling ability of the chip for just powering the IC’s brains. *Not good*. By clamping it down to 5 volts, you’re leaving more wattage capability for actually driving motors.

Fortunately, we’ve designed the ‘secret’ motor driver to take a very inexpensive, standard TO92 package-style (transistor-looking) 78L05 5 volt regulator (not included in the kit).

**Step 1:** Cut the trace. You have to isolate this pad by using a knife or other sharp instrument to cut a groove through the trace.



**Fig 3.15: Trace groove**

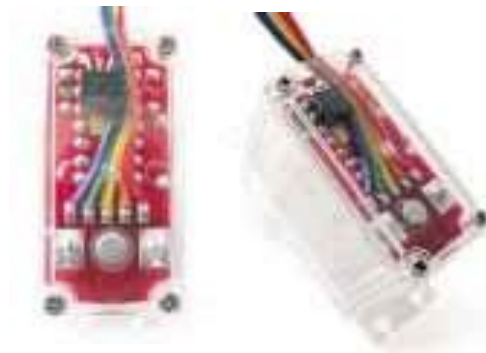
**Step 2:** Clip the 78L05 legs to about 1/3 the full length, and insert them into the two open pads. The last leg will have to be soldered to the top of the existing pad.

**NOTE:** Make sure the 78L05 is installed face up!



**Fig 3.16: clip 78L05**

**Step 3:** Thread the ribbon cable around the 78L05 and out the motor case. Slap the cover on, tighten the screws, and you're running on 5V regulated! Now feel free to crank up the voltage...



**Fig 3.17: Ribbon cable**

### 3.4 OPTION 2 – SERVO ROTATION FIXES

If you're planning to use the 'secret' motor driver in a standard servo, you will most likely have to perform a servo continuous-rotationhack. Here, we're modifying the very common Futaba S3003 / Tower Hobbies TS-53. *Most* servos can be similarly modified, but there are a few that really aren't well suited to this modification. Search the Internet for "servo rotationhack" (or similar) for which work best.

**Step 1:** After removing the screws from the bottom of the servo, pop the top 1/3 of the servo case apart. Don't worry if a gear or two comes out, as long as you have them all for re-assembly.





**Fig 3.18: Bottom servo**

**Step 2:** We're after the big black output gear. See how there's a tab on the side? We need to cut it off so that it can spin all the way around.



**Fig 3.19: Black output gear**

**Step 3:** Use a razor, thin saw, or carving tool to remove the tab. We don't recommend cutters or snips, as we've cracked the whole gear when snipping the tab off! Test your trim job by putting the gear by itself back into the top servo housing, and spin it around to make sure it isn't rubbing



**Fig 3.20: Black top servo**

**Step 4:** Reassemble the servo gear train, put the top housing back in place, and finish installing the motor driver.

There! Go forth and terrorize the world with mutant modified servos!



**Fig 3.21: Reassemble servo gear**

### 3.5 OPTION 3 - BREADBOARD USE

So you don't want to build a robot yet - what are you gonna do? Build the 'secret' motor driver anyways, and use it on the breadboard! You're going to need seven (7) pins to complete this option.

**Step 1:** Build the motor driver as per usual, and gather your pins.



**Fig 3.22: Motor driver pins**

**Step 2:** If you have to, snap off two singles from the pin set.



**Fig 3.23: pin set**

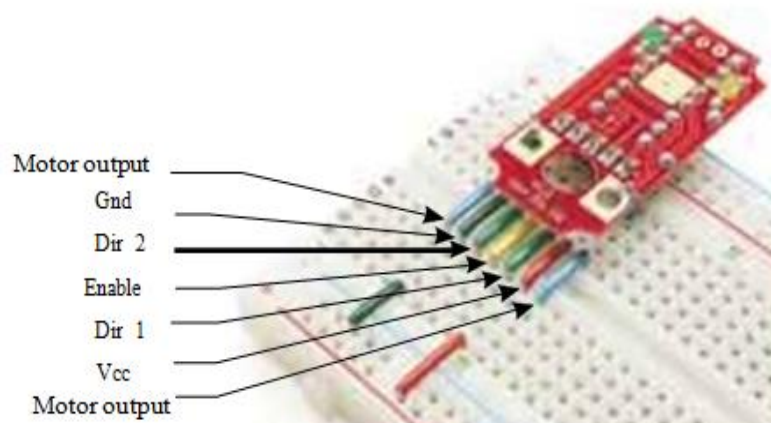


**Step 3:** Solder the pins into the holes on the bottom of the PCB near the pin function labels. You may need to open up the holes a bit to make them fit.



**Fig 3.24: Bottom of the PCB**

**Step 4:** Insert the driver board into your favorite breadboard! We found having small jumpers to the other side of the breadboard makes configuring connections easy.



**Fig 3.25: Breadboard**

### 3.6 SGS THOMPSON DATASHEET CHARACTERISTICS

- Logic / Motor supply maximum voltage V to 36V
- Input & enable line voltage range V
- Peak output current (non repetitive),  $t \leq 100\mu\text{s}$  (per 2 channels)  $\pm 2.4\text{A}$
- Continuous output current (per 2 channels) 1.2A
- Total continuous heat dissipation 4W
- Maximum switching frequency (i.e.: PWM applications) 5kHz

### 3.7 PERFORMANCE CHARACTERISTICS

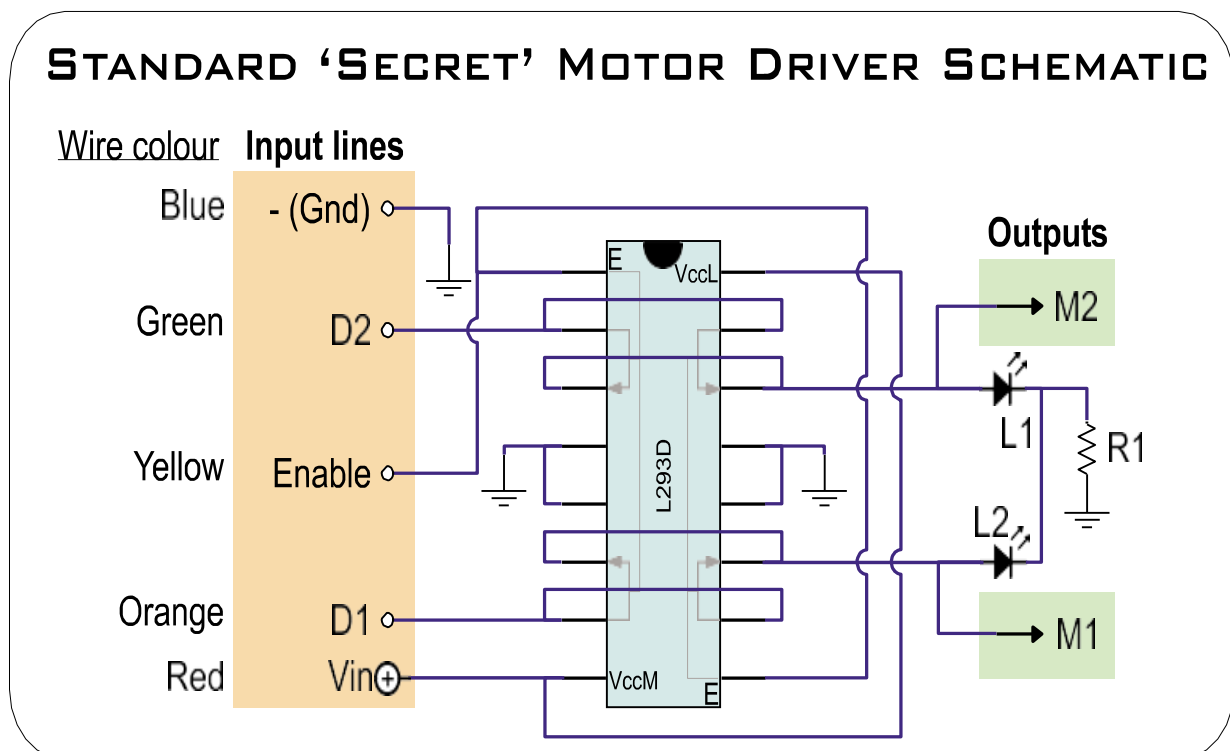
Here's the natty gritty on the SGS Thompson L293D chip as we tested it.

**Logic TABLE**

Inputs			M1, M2 Output
Enable	D1	D2	
H	H	H	Both outputs HIGH (motor brake)
H	L	L	Both outputs LOW (motor brake)
H	H	L	Current flow from M1 to M2 (rotates dir 1)
H	L	H	Current flow from M2 to M1 (rotates dir 2)
L	X	X	High impedance (motor coasts)

X = Doesn't matter  
H = Logic High  
L = Logic Low

### 3.8 SCHEMATICS STRUCTURE



**Fig 3.26: Standard secret motor driver schematic**

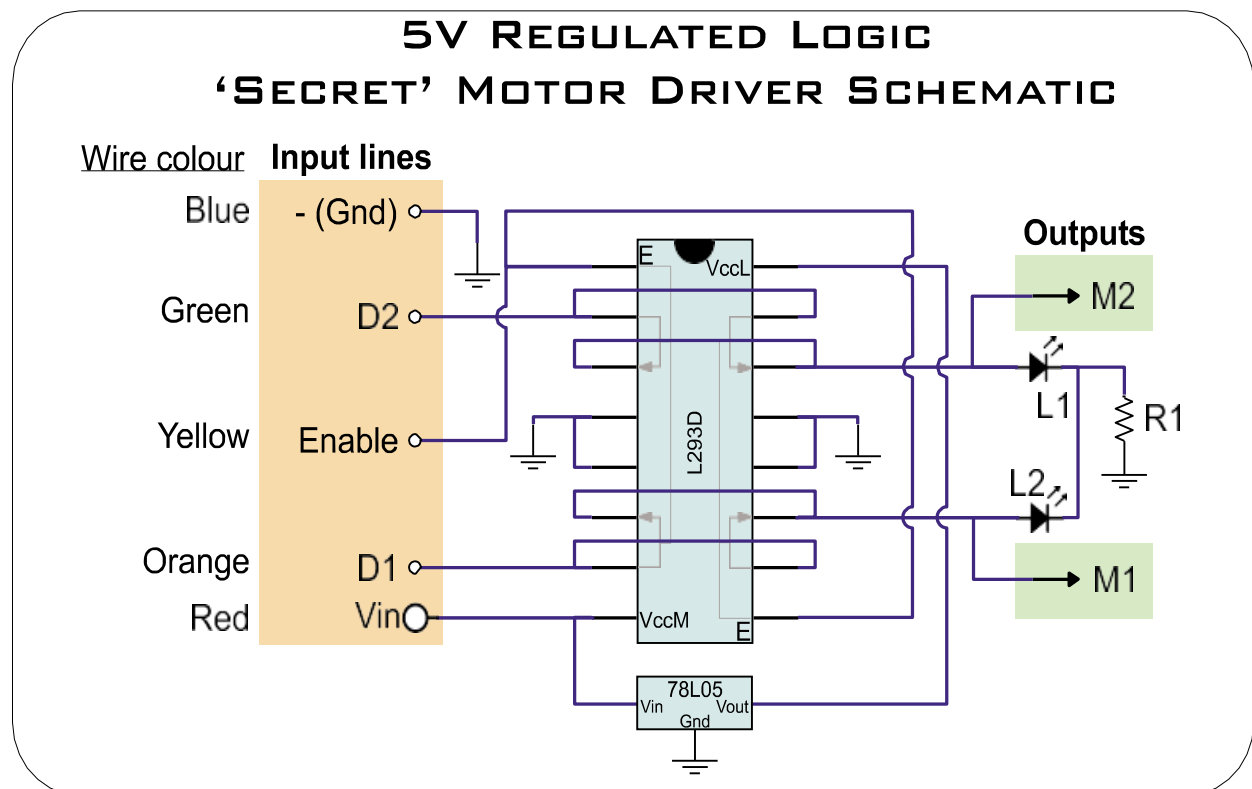


Fig 3.27: regulated logic secret motor driver schematic

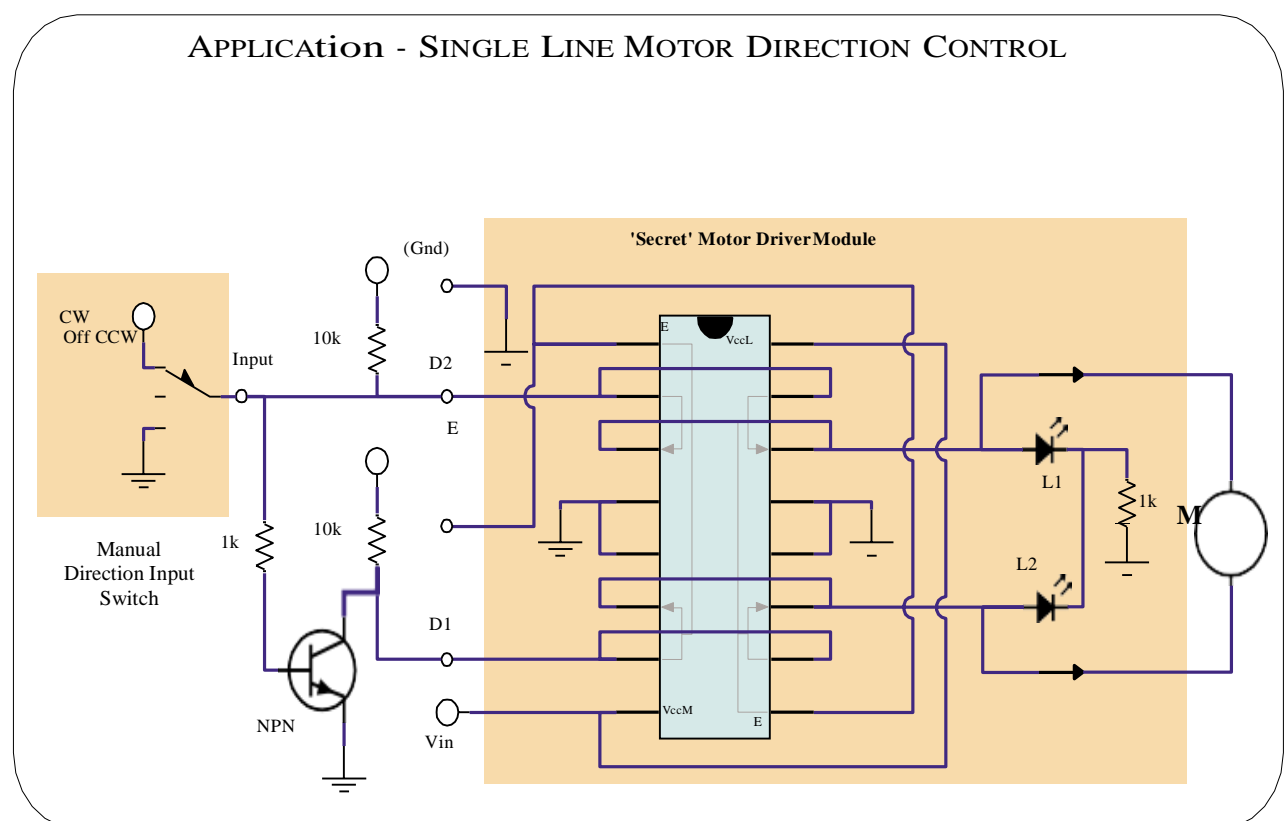


Fig 3.28: Single line motor direction control



Here's a simple 1-wire control interface. Connect the input to Vcc for rotation 1 way, Gnd for rotation the other way, and nothing at all (high impedance) for "Brake".

### **3.9 SCHEMATICS AND OTHER INSTALLATION**

The 'secret' motor driver also fits well on the outside of the Solarbotics GM2 and GM3 gearmotor. Run the ribbon cable the other way off the driver PCB through the motor hole (for stress relief), and glue the top of the L293D IC to the gear motor case.



**Fig 3.29: Run the wires through the hole**

Use short lengths of wire to connect the output pads of the motor driver to the motor contacts, and you're in business. In the case of the dog-leg inline GM2 motor, you might want to trim off one of the motor retainer clamps so you have a convenient flat mounting location.



**Fig 3.30: The GM3 installation**



**Fig 3.31: The GM2 installation - note the clipped motor retainer under the PCB**

### **3.10 INTRODUCTION TO RASPBERRY PI**

“Children today are digital natives”, said a man I got talking to at a fireworks party last year. “I don’t understand why you’re making this thing. My kids know more about setting up our PC than I do”. I asked him if they could program, to which he replied: “Why would they want to? The computers do all the stuff they need for them already, don’t they? Isn’t that the point?” As it happens, plenty of kids today aren’t digital natives. We have yet to meet any of these imagined wild digital children, swinging from ropes of twisted-pair cable and chanting war songs in nicely parsed Python.

In the Raspberry Pi Foundation’s educational outreach work, we do meet a lot of kids whose entire interaction with technology is limited to closed platforms with graphical user interfaces (GUIs) that they use to play movies, do a spot of word-processed homework and play games. They can browse the web, upload pictures and video, and even design web pages. (They’re often better at setting the satellite TV box than Mum or Dad, too) It’s a useful tool set, but it’s shockingly incomplete, and in a country where 20% of households still don’t have a computer in the home, even this toolset is not available to all children.

Despite the most fervent wishes of my new acquaintance at the fireworks party, computers don’t program themselves. We need an industry full of skilled engineers to keep technology moving forward, and we need young people to be taking those jobs to fill the pipeline as older engineers retire and leave the industry. But there’s much more to teaching a skill like programmatic thinking than breeding a new generation of coders and hardware hackers. Being able to structure your creative thoughts and tasks in complex, non-linear ways is a learned talent, and one that has huge benefits for everyone who acquires it, from historians to designers, lawyers and chemists.

### **3.11 PROGRAMMING IS FUN**

It’s enormous, rewarding, creative fun. You can create gorgeous intricacies, as well as (much more gorgeous, in my opinion) clever, devastatingly quick and deceptively simple-looking routes through, under and over obstacles. You can make stuff that’ll have other people looking on jealously, and that’ll make you feel wonderfully smug all afternoon. In my day job, where I design the sort of silicon chips that we use in the Raspberry Pi as a processor and work on the low-level software that runs on them, I basically get paid to sit around all day playing. What could be better than equipping people to be able to spend a lifetime doing

that? It's not even as if we're coming from a position where children don't want to get involved in the computer industry. A big kick up the backside came a few years ago, when we were moving quite slowly on the Raspberry Pi project. This meant that occasionally, motivation was hard to come by when all wanted to do in the evening was slump in front of the Arrested Development boxed set with a glass of wine.

### **3.12 A BIT OF HISTORY**

I started work on a tiny, affordable, bare-bones computer about six years ago, when I was a Director of Studies in Computer Science at Cambridge University. I'd received a degree at the University Computer Lab as well as studying for a PhD while teaching there, and over that period, I'd noticed a distinct decline in the skillset of the young people who were applying to read Computer Science at the Lab. From position in the mid-1990s, when 17-year-olds wanting to read Computer Science had come to the University with a grounding in several computer languages, knew a bit about hardware hacking, and often even worked in assembly language, we gradually found ourselves in a position where, by 2005, those kids were arriving having done some HTML—with a bit of PHP and Cascading Style Sheets if you were lucky. They were still fearsomely clever kids with lots of potential, but their experience with computers was entirely different from what we'd been seeing before. The Computer Science course at Cambridge includes about 60 weeks of lecture and seminar time over three years. If you're using the whole first year to bring students up to speed, it's harder to get them to a position where they can start a PhD or go into industry over the next two years. The best undergraduates—the ones who performed the best at the end of their three-year course—were the ones who weren't just programming when they'd been told to for their weekly assignment or for a class project.

They were the ones who were programming in their spare time. So the initial idea behind the Raspberry Pi was a very parochial one with a very tight (and pretty unambitious) focus: I wanted to make a tool to get the small number of applicants to this small university course a kick start. My colleagues and I imagined we'd hand out these devices to school kids at open days, and if they came to Cambridge for an interview a few months later, we'd ask what they'd done with the free computer we'd given them. Those who had done something interesting would be the ones that we'd be interested in having in the program. We thought maybe we'd make a few hundred of these devices, or best case, a lifetime production run of a few thousand.



## **So what can you do with the Raspberry Pi**

The beauty of the Raspberry Pi is that it's just a very tiny general-purpose computer (which may be a little slower than you're used to for some desktop applications, but much better at some other stuff than a regular PC), so you can do anything you could do on a regular computer with it. In addition, the Raspberry Pi has powerful multimedia and 3D graphics capabilities, so it has the potential to be used as a games platform, and we very much hope to see people starting to write games for it. We think physical computing—building systems using sensors, motors, lights and microcontrollers—is something that gets overlooked in favor of pure software projects in a lot of instances, and it's a shame, because physical computing is massive fun. To the extent that there's any children's computing movement at the moment, it's a physical computing movement.

## **ARM vs. x86**

The processor at the heart of the Raspberry Pi system is a Broadcom BCM2835 system-on-chip (SOC) multimedia processor. This means that the vast majority of the system's components, including its central and graphics processing units along with the audio and communications hardware, are built onto that single component hidden beneath the 256 MB memory chip at the centre of the board.

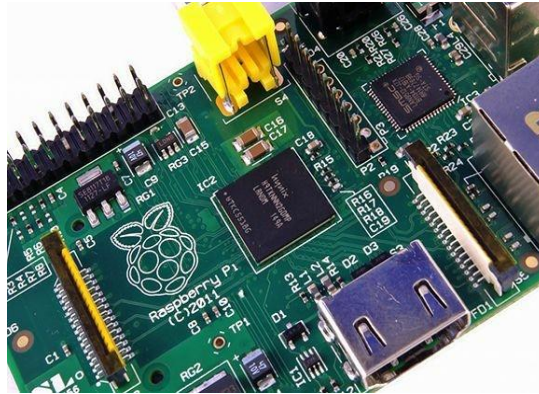
It's not just this SOC design that makes the BCM2835 different to the processor found in your desktop or laptop, however. It also uses a different instruction set architecture (ISA), known as ARM.

Developed by Acorn Computers back in the late 1980s, the ARM architecture is a relatively uncommon sight in the desktop world. Where it excels, however, is in mobile devices: the phone in your pocket almost certainly has at least one ARM-based processing core hidden away inside. Its combination of a simple reduced instruction set (RISC) architecture and low power draw make it the perfect choice over desktop chips with high power demands and complex instruction set (CISC) architectures.

The ARM-based BCM2835 is the secret of how the Raspberry Pi is able to operate on just the 5V 1A power supply provided by the onboard micro-USB port. It's also the reason why you won't find any heat-sinks on the device: the chip's low power draw directly

translates into very little waste heat, even during complicated processing tasks. It does, however, mean that the Raspberry Pi isn't compatible with traditional PC software.

The majority of software for desktops and laptops is built with the x86 instruction set architecture in mind, as found in processors from the likes of AMD, Intel and VIA. As a result, it won't run on the ARM-based Raspberry Pi.



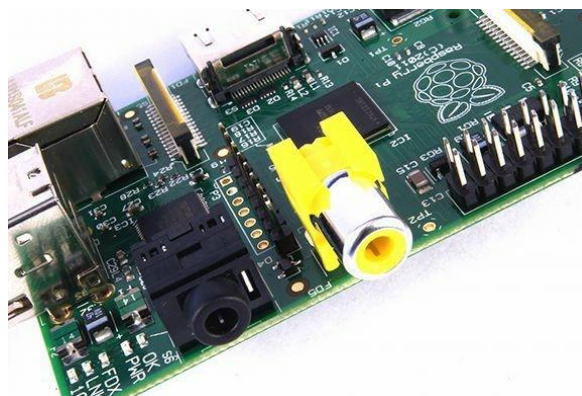
**Fig 3.32: The BCM2835 SOC, located beneath memory chip**

### 3.13 WINDOWS VS LINUX

As with the difference between ARM and x86, there's a key point to make about the practical difference between Windows, OS X and Linux: software written for Windows or OS X won't run on Linux.

#### **Composite Video**

Composite video, available via the yellow-and-silver port at the top of the Pi known as an RCA phone connector is designed for connecting the Raspberry Pi to older display devices.



**Fig 3.33: The yellow RCA phone connector, for composite video output**  
**Getting Started with the Raspberry Pi**

Now that you have a basic understanding of how the Pi differs from other computing devices, it's time to get started. If you've just received your Pi, take it out of its protective anti-static bag and place it on a flat, non-conductive surface before continuing with this chapter.

### **Connecting a Display**

Before you can start using your Raspberry Pi, you're going to need to connect a display. The Pi supports three different video outputs: composite video, HDMI video and DSI video. Composite video and HDMI video are readily accessible to the end user, as described in this section, while DSI video requires some specialized hardware.

When no other display device is available, a composite video connection will get you started with the Pi. The quality, however, isn't great. Composite video connections are significantly more prone to interference, lack clarity and run at a limited resolution, meaning that you can fit fewer icons and lines of text on the screen at once.

Another important difference between the Raspberry Pi and your desktop or laptop, other than the size and price, is the operating system—the software that allows you to control the computer. The majority of desktop and laptop computers available today run one of two operating systems: Microsoft Windows or Apple OS X. Both platforms are closed source, created in a secretive environment using proprietary techniques. These operating systems are known as closed source for the nature of their source code, the computer-language recipe that tells the system what to do. In closed-source software, this recipe is kept a closely-guarded secret. Users are able to obtain the finished software, but never to see how it's made.

The Raspberry Pi, by contrast, is designed to run an operating system called GNU/Linux—hereafter referred to simply as Linux. Unlike Windows or OS X, Linux is open source: it's possible to download the source code for the entire operating system and make whatever changes you desire. Nothing is hidden, and all changes are made in full view of the public. This open source development ethos has allowed Linux to be quickly altered to run on the Raspberry Pi, a process known as porting. At the time of this writing, several versions of Linux—known as distributions—have been ported to the Raspberry Pi's BCM2835 chip, including Debian, Fedora Remix and Arch Linux.

The different distributions cater to different needs, but they all have something in common: they're all open source.



### **3.14 HDMI VIDEO**

A better-quality picture can be obtained using the HDMI (High Definition Multimedia Interface) connector, the only port found on the bottom of the Pi. Unlike the analogue composite connection, the HDMI port provides a high-speed digital connection for pixel-perfect pictures on both computer monitors and high-definition TV sets.



**Fig 3.34: The silver HDMI connector, for high-definition video output**

Using the HDMI port, a Pi can display images at the Full HD 1920x1080 resolution of most modern HDTV sets. At this resolution, significantly more detail is available on the screen.

### **3.15 CONNECTING A KEYBOARD AND MOUSE**

Now that you've got your Raspberry Pi's output devices sorted, it's time to think about input. As a bare minimum, you're going to need a keyboard, and for the majority of users, a mouse or trackball is a necessity too.



**Fig 3.35: Model B's two USB ports**

Depending on whether you purchased the Model A or Model B, you'll have either one or two USB ports available on the right side of the Pi. If you're using Model B, you can connect the keyboard and mouse directly to these ports. If you're using Model A, you'll need to purchase a USB hub in order to connect two USB devices simultaneously.

A USB hub is a good investment for any Pi user: even if you've got a Model B, you'll use up both your available ports just connecting your keyboard and mouse, leaving nothing free for additional devices such as an external optical drive, storage device or joystick. Make sure you buy a powered USB hub: passive models are cheaper and smaller, but lack the ability to run current-hungry devices like CD drives and external hard drives.

### 3.16 CONNECTING A KEYBOARD AND MOUSE

Now that you've got your Raspberry Pi's output devices sorted, it's time to think about input. As a bare minimum, you're going to need a keyboard, and for the majority of users, a mouse or trackball is a necessity too. First, some bad news: if you've got a keyboard and mouse with a PS/2 connector—a round plug with a horseshoe-shaped array of pins—then you're going to have to go out and buy a replacement. The old PS/2 connection has been superseded, and the Pi expects your peripherals to be connected over the Universal Serial Bus (USB) port.

Depending on whether you purchased the Model A or Model B, you'll have either one or two USB ports available on the right side of the Pi. If you're using Model B, you can connect the keyboard and mouse directly to these ports. If you're using Model A, you'll need to purchase a USB hub in order to connect two USB devices simultaneously.



**Fig 3.36: Model B's two USB ports**

A USB hub is a good investment for any Pi user: even if you've got a Model B, you'll use up both your available ports just connecting your keyboard and mouse, leaving nothing free for additional devices such as an external optical drive, storage device or joystick. Make sure you buy a powered USB hub: passive models are cheaper and smaller, but lack the ability to run current-hungry devices like CD drives and external hard drives.

If your monitor has a VGA input—a D-shaped connector with 15 pins, typically colored silver and blue—the Raspberry Pi can't connect to it. Adapters are available that will take in a digital DVI signal and convert it to an analogue VGA signal, but these are expensive and bulky. The best option here is simply to buy a more-modern monitor with a DVI or HDMI input.

### **3.17 DSI VIDEO**

The final video output on the Pi can be found above the SD card slot on the top of the printed circuit board—it's a small ribbon connector protected by a layer of plastic. This is for a video standard known as Display Serial Interface (DSI), which is used in the flat-panel displays of tablets and smart phones. Displays with a DSI connector are rarely available for retail purchase, and are typically reserved for engineers looking to create a compact, self-contained system. A DSI display can be connected by inserting a ribbon cable into the matched connector on the Pi, but for begins the use of a composite or HDMI display is recommended.

### **3.18 CONNECTING AUDIO**

If you're using the Raspberry Pi's HDMI port, audio is simple: when properly configured, the HDMI port carries both the video signal and a digital audio signal. This means that you can connect a single cable to your display device to enjoy both sound and pictures. Assuming you're connecting the Pi to a standard HDMI display, there's very little to do at this point. For now, it's enough to simply connect the cable. If you're using the Pi with a DVI-D monitor via an adapter or cable, audio will not be included. This highlights the main difference between HDMI and DVI: while HDMI can carry audio signals, DVI cannot. For those with DVI-D monitors, or those using the composite video output, a black 3.5 mm audio jack located on the top edge of the Pi next to the yellow phone connector provides analogue audio. This is the same connector used for headphones and microphones on consumer audio.



equipment, and it's wired in exactly the same way. If you want, you can simply connect a pair of headphones to this port for quick access to audio.

### **3.19 CONNECTING EXTERNAL STORAGE**

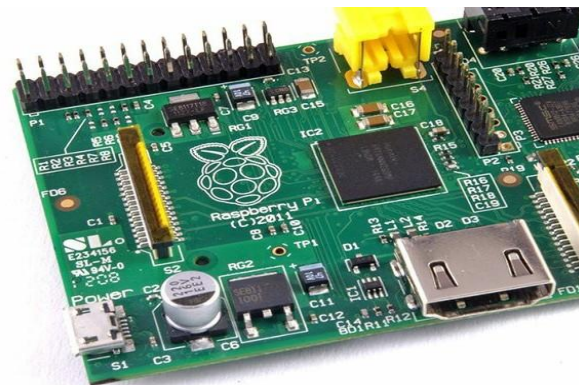
While the Raspberry Pi uses an SD card for its main storage device—known as a boot device—you may find that you run into space limitations quite quickly. Although large SD cards holding 32 GB, 64 GB or more are available, they are often prohibitively expensive. Thankfully, there are devices that provide an additional hard drive to any computer.



**Fig 3.37: Two USB Mass Storage devices: a pen drive and an external hard drive**

### **3.20 POWER DIAGNOSTICS**

Many problems with the Raspberry Pi can be traced to an inadequate power supply. The Model A requires a 5 V supply capable of providing a 500 mA current, while the Model B's extra components bump up the current requirement to 700 mA. Not a 1 USB power adapters are designed to offer this much power, even if their labeling claims otherwise. If you're having intermittent problems with your Pi—particularly if it works until you connect something to a USB port or start a processor-intensive operation like playing video—the chances are that the power supply in use is inadequate.



**Fig 3.38: The two voltage test points, labeled TP1 and TP2**

To use the voltage test points, you'll need a voltmeter or multi meter with direct current (DC) voltage measuring capabilities. If your meter has multiple inputs for different voltages, use an appropriate setting. The two test points are small, copper-clad holes known as visa, which are connected to the Pi's 5 V and ground circuits. Put the positive (red) meter probe on TP1, located to the left of the board just above a small black component called a regulator labeled RG2. Connect the black (negative) meter probe to TP2, located between the copper GPIO pins and the yellow-and-silver RCA phone connector at the top-left of the board. The reading on the voltmeter should be somewhere between 4.8 V and 5 V. If it's lower than 4.8 V, this indicates that the Pi is not being provided with enough power. Try swapping the USB adapter for a different model, and check that the label says it can supply 700 mA or more. A model rated at 1A is recommended, but beware of cheap models—they sometimes have inaccurate labeling, and fail to supply the promised current.

Genuine branded mobile phone chargers rarely have this problem, but cheap unbranded devices—often sold as compatible adapters—should be avoided. If your voltmeter reads a negative number, don't worry: this just means you've got the positive and negative probes in the wrong place. Either swap them around or just ignore the negative sign when noting your reading.

### **3.21 DISPLAY DIAGNOSTICS**

Although the Pi is designed to work with almost any HDMI, DVI or composite video display device, it simply may not work as expected when you plug it in. For example, you may find that your picture is shifted to the side or not fully displayed, or is only visible as a postage-stamp-sized cut-out in the middle of the screen or in black-and-white—or even missing entirely. First, check the type of device to which the Pi is connected. This is especially important when you're using the composite RCA connection to plug the Pi into a TV. Different countries use different standards for TV video, meaning that a Pi configured for one country may not work in another. This is the usual explanation for a Pi showing black-and-white video. You'll learn how to adjust this setting in Chapter 6, "Configuring the Raspberry Pi". When you use the HDMI output, the display type is usually automatically detected.

If you're using an HDMI to DVI adapter to plug the Pi into a computer monitor, however, this occasionally goes awry. Common symptoms include snow-like static, missing

picture portions or no display at all. To fix this, note the resolution and refresh rate of your connected display, and then jump to Chapter 6 to find out how to set these manually.

Another issue is a too-large or too-small image, either missing portions at the edge of the screen or sitting in the middle of a large black border. This is caused by a setting known as over scan, which is used when the Pi is connected to TVs to avoid printing to portions of the display which may be hidden under a bezel.

### **3.22 BOOT DIAGNOSTICS**

The most common cause for a Pi to fail to boot is a problem with the SD card. Unlike a desktop or laptop computer, the Pi relies on files stored on the SD card for everything. If Pi can't talk to the card, it won't display anything on the screen or show any signs of life at all.

If your Pi's power light glows when you connect the micro-USB power supply, but nothing else happens and the OK light remains dark, you have an SD card problem. First, ensure that the card works when you connect it to a PC, and that it shows the partitions and files expected of a well-flashed card. (For more details, "Linux System Administration", particularly the section titled "File System Layout" in that chapter.) If the card works on a PC but not in the Pi, it may be a compatibility problem. Some SD cards—especially high-speed cards marked as Class 10 on their labeling—don't operate correctly when connected to the Pi's onboard SD card reader.

A list of cards known to cause compatibility problems with the Pi can be found on the Linux wiki: Sadly, if you have one of the cards on the list, you may need to replace it with a different card in order for the Pi to work. As the Pi's software base is developed, however, work is being carried out to ensure that a wider range of cards operate correctly with the Pi. Before giving up on a high-speed card completely, check to see if an updated version of your chosen Linux distribution is available. (See Chapter 1, "Meet the Raspberry Pi", for more information about distributions.)

### **3.23 NETWORK DIAGNOSTICS**

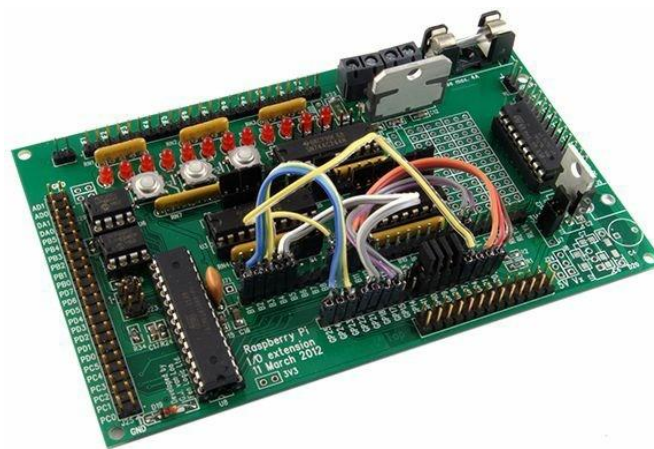
The most useful tool for diagnosing network problems is ifconfig. If you're using a wireless network connection, "Network Configuration", for information on a similar tool for those devices. Otherwise, read on. Designed to provide information on connected network ports, ifconfig is a powerful tool for controlling and configuring the Pi's network ports.



For its most basic usage, simply type the tool's name in the terminal: If configure Called in this manner, if configure provides information on all the network ports it can find.

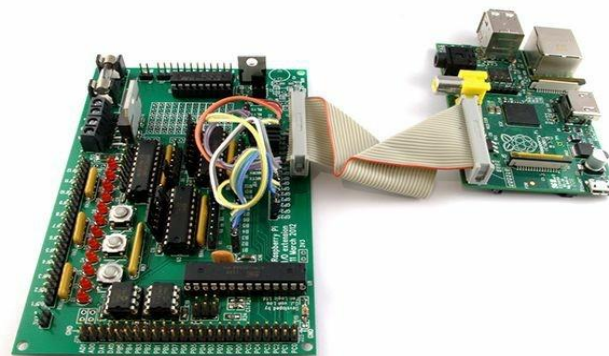
### **3.24 FEN LOGIC GARBOARD**

Properly termed the Raspberry Pi I/O Extension, the Gar board is named for its inventor Gar van. An employee of Broadcom and a member of the team that designed the BCM2835 SOC processor at the heart of the Raspberry Pi, van Look created the Gar board as a way of unlocking some of the power of the chip hidden by the Pi's overall design and providing a powerful and versatile platform for electronic tinkering.



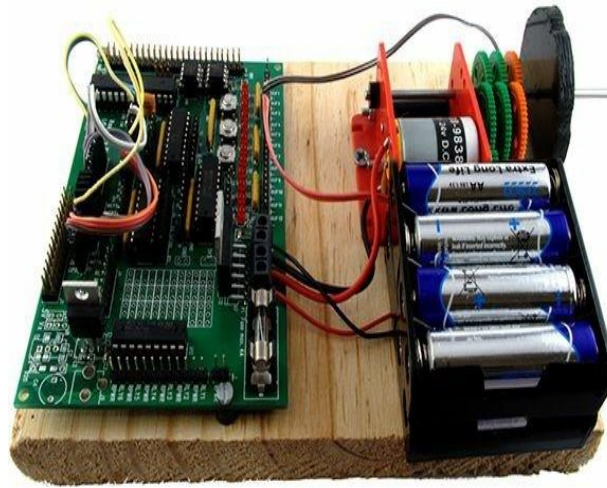
**Fig 3.39: The Garboard, designed by Gar van**

Unlike the Slice of Pi and Prototyping Pi Plate, the Garboard is an active add-on board with numerous components designed to extend the functionality of the Pi. The Garboard provides 12 buffered IO ports with status LEDs, three push-button switches, six open collector drivers, a 48 V 4 A motor controller, a two-channel digital to analogue converter (ADC) and a two-channel analogue to digital converter (DAC).



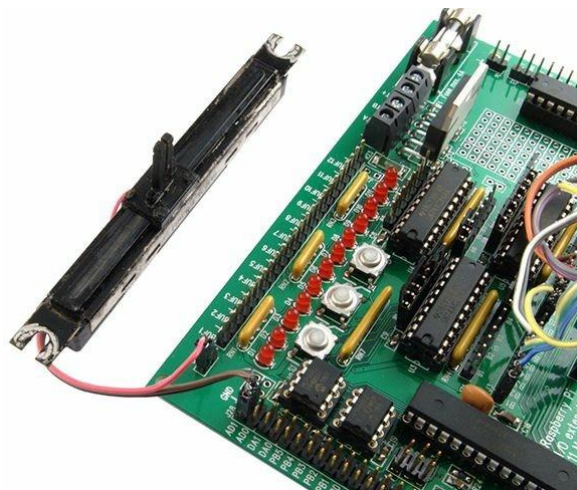
**Fig 3.40: The Garboard connected to a Raspberry Pi**

Additionally, the Garboard has support for an additional 28-pin microcontroller, such as the Atmel ATmega328 used in the Arduino prototyping system, which can be inserted into a socket on the Garboard and programmed directly from the Raspberry Pi.



**Fig 3.41: Using the Garboard motor controller**

Perhaps the most important feature of the Garboard is the protection it offers to the Pi. Using a 3.3 V regulator, the Garboard is designed to prevent the Pi's GPIO port from receiving voltages it cannot handle. Like the Slice of Pi, it also attempts to restrict access to the six pins labeled Do Not Connect as well as the 3.3 V and 5 V pins to help prevent accidental shorting. Although care must be taken while wiring up circuits, following the instructions included in the Garboard's user manual guarantees the Pi's safety.



**Fig 3.42: Connecting a potentiometer to the Garboard's ADC pins**

The motor controller functionality of the Garboard makes it easy to integrate the Pi into a robotics project. It's suitable for motors of up to 48 V at 4A, which is easily powerful

enough to drive a small robot vehicle. Sadly, the motor is not included as standard with the Garboard. Instead, you are asked to supply your own controller—with the L6203 package being recommended—if motor control forms part of your project. With the motor controller soldered into place, the Garboard can be used to control surprisingly powerful motors either through instructions received from the Pi itself or from the optional Atmel microcontroller module. Shows an example circuit that's using the Garboard to drive a 12 V motor from a battery pack power supply.

As the list of features indicates, the Garboard is a powerful and complex device. Its flexibility makes it a great choice for more complex projects—but that same complexity affects its size. The Garboard is almost two-and-a-half times larger than the Raspberry Pi itself, making it both the most powerful and the largest add-on board for the Pi available at the time of writing. To counteract its size, the Garboard connects to the Pi through a ribbon cable terminated in male sockets. This cable allows the Garboard to sit away from the Pi, or to be mounted in a project permanently yet still be quickly detached from the Pi if necessary.

Finally, the Garboard provides access to a 28-pin microcontroller, which can be fitted to a socket located on the board itself. When fitted, the Garboard can be wired to address either the Raspberry Pi's GPIO port or the microcontroller, or a combination of the two. The Garboard is designed to operate with an Atmel ATmega168 or ATmega328 microcontroller—the same type of microcontroller used in the Arduino prototyping project. When fitted, you can write programs for the Garboard ATmega microcontroller in the Atmel IDE, giving the Pi a useful level of compatibility with the wide array of existing ATmega-targeted software available to download. It also gives the Pi the ability to address external hardware in a real-time manner, with the microcontroller taking over responsibility for hardware interfacing and simply providing feedback to the Pi.

Hundreds of different distributions are available for desktops, laptops and even mobile devices; and Google's popular Android platform is developed on top of a Linux core. If you find that you enjoy the experience of using Linux on the Raspberry Pi, you could consider adding it to other computing devices you use as well. It will happily coexist with your current operating system, allowing you to enjoy the benefits of both while giving you a familiar environment when your Pi is unavailable.



## **CHAPTER – 4**

# **HARDWARE AND SOFTWARE REQUIREMENTS**

### **Hardware requirements:**

- Microprocessor-Raspberry Pi
- LCD - 16 x 2
- Soil Moisture sensor
- Motor
- PH sensor
- Temperature sensor
- Anti noise
- Rodent repeller
- Power supply

### **Software requirements**

- Python
- Linux
- IoT

## **CHAPTER – 5**

### **TECHNICAL SPECIFICATIONS**

- Operating voltage of embedded circuitry is 5vdc for 8051 and 3.3v for Raspberry Pi
- Current consumption of device in active mode 200mill amp
- Operating frequency of device is 11.0592MHZ for 8051 and 40 60 MHZ for ARM

## **CHAPTER – 6**

### **ADVANTAGES AND APPLICATIONS**

#### **Advantages:**

- No need of employees.
- Allows farmer to interact with market.
- Avoid middle men interference.
- Increases yield since advanced farming have been introduced.
- Increases the productivity.
- It saves water and formers time.
- Compact and low cost.
- Fast operation because RISC architecture embedded chip is used.
- Operates the water pump automatically.

#### **Applications:**

- Large agricultural fields.
- Solar powered irrigation
- Home Gardens.
- Agricultural lands in rural areas.
- Forests development.



## **CONCLUSION**

By implementing the proposed system there are various benefits for the government and the farmers. For the government a solution for energy crisis is proposed. By using the automatic irrigation and smart farming system it optimizes the usage of water by reducing wastage and reduces the human intervention for farmers. Proposed system is easy to implement and environment friendly solution for irrigating fields. Even though there is a high capital investment required for this system to be implemented, the overall benefits are high and in long run this system is economical. Since most of the Indians involve in Farming with this we can take the farming to the next higher version since higher technologies have been introduced in this project leading in economy growth, increase of productivity, many people adopting the smart farming and in turn leads for more earnings.

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