# INDIGENOUS DESIGN OF AN AUTONOMOUS AGRICULTURAL ROBOT FOR REMOTE AREA FARMING

**A PROJECT REPORT**

***Submitted by***



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# Adhiyamaan College of Engineering (Autonomous), Hosur

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## BONAFIDE CERTIFICATE

Certified that this project report **"INDIGENOUS DESIGN OF AN AUTONOMOUS AGRICULTURAL ROBOT FOR REMOTE AREA FARMING"** is the bonafide work of "**V.VISHNU, B.BHARANI DHARAN S.VISZAGAN, , S.I.MOHAMED ABUBACKER RASHEEQ"** who carried out the project work under my supervision.

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## ABSTRACT

The project presents an autonomous agricultural robot that is able to plant a small number of seeds of different species at predefined positions. The agricultural robot (Agrobot) works completely on Image processing for control and perform drilling and seed sowing task. The vehicle is designed with wide wheels that can travel on any rough surface to reach the destination in the agricultural field. The high torque motors are attached with the wheels that are able to carry the heavy vehicle and the drilling motor is placed vertical to drill through the ground. The gravity mechanism is used to drop the seeds with funnel and servo attached for control. The digital camera is placed in the front end of the vehicle to capture the position where the seed should be dropped. The microprocessor of the system is controlled by ARM processor, which is a credit-card-sized single-board computer loaded with Linux as operating system. The microprocessor performs the image processing task like searching, identifying, recognizing objects and path tracking. Arduino is the microcontroller used in the system to control the motor signals. Microcontroller acts as the bridge between microprocessor and motors in speed and direction control. A mobile robot which can drill and sow seeds autonomously was developed. A similar manipulator as in the static solution is intended to be used. Several locomotion and localization concepts have been evaluated and it is proposed to use a differential drive platform combined with image processing. Applications are many and various, but there is still great scope for further innovation. A constant grumble is the shortage of manpower for farming, both skilled and for seasonal harvesting operations. Intelligent agricultural robotics is welcomed in most essential industry. The project can be extended in further by adding a compass, GPS and laser techniques for navigation purpose.

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## COMPANY PROFILE


Bangalore Robotics Pvt. Ltd is one of the leading Robotics R&D industries in India, The Robotics extension of the 37 year old ***Docel Radio Research***, directed by Dr.G.Venkatesh. In its 14th year, The company on various design of Robotics like AUV, UAV and Autonomous systems. The company is also a dedicated Group with the firm commitment of educating the students with a Practical and Design oriented approach, without ensuing dependence.

### Purpose

Our basic intention is to propagate multi-faceted talents and facilitate aptitude build-up in students. Our sole purpose is to make learning an enjoyable and fascinating through a practical, down-to-earth approach to the mundane aspects of theoretical studies.

### Organization

The purpose of this group is to increase the popularity of our common interests- Robotics & Mechatronics. We also want to have fun while when we are together and working on Projects. By developing relationships and friendships, the group will become even more strong and meaningful.

### Mission

Our mission is to further promote the interests of our group and our members to the community. We strive to make a difference by educating the public and expanding our reach.

We do not follow a Class Room approach nor do we indulge in spoon feeding. We follow the unconventional method where WE ALL learn together. We encourage interaction and individual ideas rather than a stereotype group activity.

Our Philosophy is to let you discover your talents yourself and to facilitate the process. We firmly believe that no science is beyond any age or qualification.

**About Mentor**

Dr. G. Venkatesh, is a veteran in the field of Robotics in India, with 32 years of experience, who has been teaching across India and abroad. He actively participates in all technical fields and guides the students with thoughts and knowledge in mastering the field. As a professor, his ideas are special among young minds and is recognized as "RoboDoc of India" in the Media.

He strongly believes that –

**"Anything is possible…..After YOU prove it !!!"**

"We have proved this 1000s of times, since 33yrs of being associated with students and people of from all walks of life."

Bangalore Robotics Pvt Ltd also promotes Students and encourages them to participate in International and National Robotics Competitions.

Team BangaloreRobotics is the only unique International Team in the world, with Students from 4 continents and many universities. It is the only ream representing India in the International MATE ROV and AUVSI RoboSub International competitions in the USA since 4 years.

# CHAPTER 1
# INTRODUCTION

## 1.1 PROJECT GOALS

The overall goal of the project is to design a robot to drop the seed in to the ground. The design is concentrated to make a simple mechanism to build a driller and seed dropper structure. Then the setup is attached to a moving robotic system to travel in the agricultural field. By automating the process, it is aimed to achieve more sophisticated results. This project is focused on the robotics component of the project, and the goal is to make a seed-planting robot. Three variants of the robot are to be developed. The first is a stationary robot which can plant seeds in the ground. The second variant is a fully autonomous mobile robot which can plant directly in an outdoor setting with variable field sizes. The third is an advanced automated robot takes the vision control form the outdoor environment and process real time circumstances. All stages of robots shall be able to handle a wide range of plant seeds, whereas different seeds can be used based on the size.

**Stage 1: Development of a Seed Dropper Structure**

In the first stage a seed dropper system for the specified seed types is to be developed. The mechanism shall be able to select a defined amount of seeds and deliver them to an outlet where they are placed. The selection mechanism is required to be designed in way that the seeds can be selected from multiple seed types, either different colors of the same species or different species.

**Stage 2: Implementation of Stationary 2D-Robot**

In a second step, the seed dropper mechanism is mounted on a static robot which allows drilling in the field and dropping seeds. This way the drilling mechanism is mounted on the robot and controlled to move in the field.

**Stage 3: Implementation with Autonomous Platform**

To allow the fully autonomous robot in the growing field, an autonomous mobile robot is to be developed in this stage. The robot shall be equipped with a manipulator based on the seed dropper system developed in the first stage. The vehicle is programmed to move automatically in the field with specific gap to travel between every drilling space.

**Stage 4: Implementation with Image Processing**

Further the robot has to be able to view and localize itself with a suitable algorithm and to plan the path on the field autonomously. If, for any reason, the achieved positioning of the robot is less than the required space for planting, the manipulator has to be designed in a way that it can compensate any misplacements of the robot in order to increase or reduce the planting space to the desired level.

## 1.2 ROBOTICS IN AGRICULTURE

Robotics made its first real appearance in the manufacturing industry, with the adoption of the name 'Robot' for the serial manipulator. Here manipulation and its related kinematics formed the core of the art, later developing into intelligent automation. As agriculture is extensively supported by technical means like seeding, mowing or harvesting machines, it is widely considered to be a field with a high potential for robotic application as it is a small step from these semi-automatically operated machines to fully autonomous robots in open field applications. Robots are available on all development levels from experimental to market-ready in several agricultural applications, but most of them are in research, where institutes have made progress to extend the existing agricultural machines to robotic systems. Most of the robots considered in this publication are developed for harvesting and weed control as these are the most expensive, often manually conducted, operations in agriculture. When the essentials of robotics are applied to the much more significant industry of agriculture, however, the emphasis must be placed much more heavily on sensing than on manipulation. Autonomous machines for robotics will be important research areas of agriculture in the future.

## 1.3 NEED FOR TECHNOLOGY

Technology is the making, modification, usage, systems, and methods of organization, in order to solve a problem, improve a pre-existing solution to a problem, achieve a goal, handle an applied input/output relation or perform a specific function. The human use of technology began with the conversion of natural resources into simple tools. The prehistorically discovery of the ability to control fire increased the available sources of food and the invention of the wheel helped humans in travelling in and controlling their environment. Recent technological developments, including the printing press, the telephone, and the Internet, have lessened physical barriers to communication and allowed humans to interact freely on a global scale. However, not all technology has been used for peaceful purposes; the development of weapons of ever-increasing destructive power has progressed throughout history, from clubs to nuclear weapons.

We need technology for a wide varied of reasons; the major reason as to why we need technology is because technology simply makes our day to day existence much easier than it used to be earlier.

The future of the project is the need of the technology where the physical work of human is reduced in the agricultural field and forest area. More manpower less system can be designed and manufactured. This helps in the improvement in the cost development of the new products in the agricultural industry.

## 1.4 BLOCK DIAGRAM

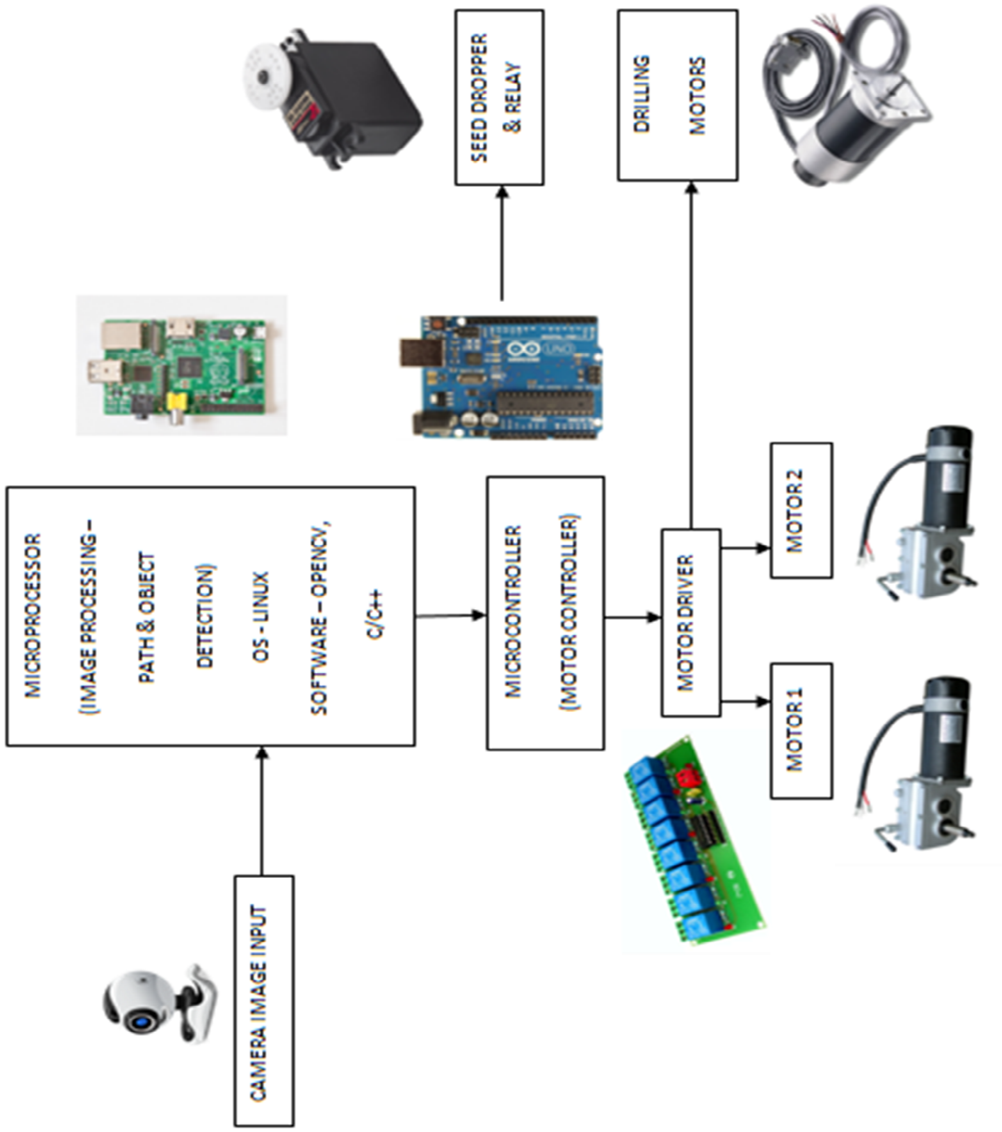


**Figure 1.1 Block Diagram**

**Description of Block Diagram**

The block diagram starts with the Logitech HD Webcam C270 as the image processing input signal mounted in the front of the robot. The video is captures by the camera and the image is processed by the microprocessor motherboard. The image processing is processed by image filtering and detection of the object. The software of the image processing section is done by Raspberry Pi microprocessor Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, VideoCore IV GPU, loaded with linux as Operating system and runs OPENCV for image processing module which is coded in C/C++. The processed image comes out with the signal output for control and navigation. The signal output is sent to the microcontroller through USB connected. Arduino 8-bit Atmel AVR architecture as the microcontroller gets the control signal and converts to the motor signal. These signals are given to the motor driver relay board and as the other end connected with wheel motors and drilling motor. The setup of the electrical board is kept safely in a box at the center of the robotic body.

The microcontroller on the other side is connected with the servo and funnel mechanism for seed dropping mechanism. The seed is dropped from the funnel to the ground when the signal is triggered by the microprocessor. The drilling motor which gets the signal from the relay board acts as the master control is decided by the microprocessor. The wheels are connected with the motors that finally move by the signal. The UB12180 Battery acts as the power supply that powers the whole robotic vehicle.

# CHAPTER 2

# LITERATURE SURVEY

## 2.1 AGRICULTURE IN INDIA

The green revolution changed the very technology that was being applied in the Indian agricultural system. It showed great results and made India agriculturally self-sufficient. But these technologies have remained untouched since then and no major improvement has been made to step up productivity to meet the demands of the burgeoning population. Some of the major problems in Indian agriculture are raising input costs, availability of skilled labor, dwindling water resources, over usage of fertilizers and lack of proper crop monitoring. Overcoming some of these problems requires tedious manual work which due to unavailability of enough labor cannot be performed. Hence, one of the solutions could be involving automation technologies in agriculture. Here, we present an agricultural robot, capable of implementing some of the methods of agriculture.

## 2.2 TECHNOLOGY DEVELOPED TILL DATE

Agriculture methods have been developed by modifying various existing methods. Pivot irrigation systems have been integrated with GIS and GPS to apply water at variable rates to the soil. Autonomous guided vehicles have been developed to perform automation in agricultural fields. Technological developments Perhaps the greatest impact on agriculture has been through the farmer’s growing awareness of computer power. Mobile computing can log the yield during harvesting, relating it to a precision map of the property. Tasks that had been merely mechanized can now be synchronized and automated. GPS (global positioning by satellite) has been seized on for mapping and guidance operations. Generic radio communication techniques use protocols that might be common to mobile telephone technology or networked systems such as Zigbee.

These systems allow remote monitoring of gates, livestock, or equipment and automatic replenishment of water troughs. They can equally contribute to fleet management and information transfer in a forestry situation. Other radio technology in the form of transponders can see each animal tagged and identified to support activities such as milking and tracking. Much farming machinery has long been hydraulically powered, but the addition of digitally controlled valves opens the way for automated steering and other ‘robot’ operations. With computing power comes the ability to analyses images from cameras that are becoming ever cheaper.

## 2.3 STATE OF THE ART OF ROBOTIC STUDIES IN AGRICULTURE

### 2.3.1 Pre-Technology

In order to understand which the research opportunities are at hand in the sector of robotic automation for agricultural processes, it is convenient to review the main research studies carried on in the last years. As remarked before agriculture is still labor intensive also in those countries in which the cost of man power is very high and robotic automation solutions are widely used in other industrial sectors. Some applications are indeed available as illustrated in Kondo and Ting (1998), but most solutions which have been developed so far mainly focus on specific problems trying to automatism single operations. The most important lines of study, for what concerns automated solutions for application in greenhouses, are related to specific cultural operations, to harvesting of different crops, and to guidance problems. In Tillet (1993) an excellent overview on robotic applications in horticulture is presented. Transplanting and seeding are some of the cultural operations whose automation has been specifically studied in the works of Ryu et al. (2001) and of Taiet al. (1994).

### 2.3.2 Technology After 1999

In the wide chapter of automated harvesting Kondo and Monta (1999)introduce a strawberry harvesting robot, while Reed et al. (2001) address the automatic harvesting of cultivated mushrooms. Cho et al. (2002) consider a lettuce harvesting robot equipped with a computer vision system, while an automated cucumber picking by a robot was studied by Van Henten et al. (2002) and (2003). For what concerns applications in the field, automatic guidance has attracted consistent research efforts. Automatic guidance systems for tractors and for other specific machines such as harvesters, transplanters, etc. have been implemented based on different technological solutions. A particular section is represented by studies which use stereoscopic visions in the works of Kise et al. (2005) and Rovida Màs et al. (2004). The second technological solution which was studied in more recent years is based on the use of global navigation satellite systems (GNSS) presently represented by the American global positioning system (GPS). The joint use of GPS and artificial vision has been proposed by Benson et al. (2003) and Chen et al. (2003), while solutions based on lasers (Jimenez et al., 1999), (Château et al., 2000) and ultrasonic sensing(Harper & Mc Kerrow, 2001) have been also investigated. Final fields of study for automated applications in the field are represented by robotic solutions for harvesting, as illustrated by the works of Monta et al. (1995), Sarig (1993), Sanders (2005) and Peterson et al. (1999), and mapping yield and fruit quality (Quiao et al., 2005). It is worth noting that most studies in literature deal with one specific agricultural operation for which automated solutions are studied and presented. This ends up in most cases with the design and testing of a dedicated machine that is often even quite sophisticated, but can perform only one operation. The case of multipurpose robots that can perform different tasks is usually an exception although some studies in this category (Monta et al. 1995, VanHenten et al. 2002, 2003, and 2006) are also available.

## 2.4 DESIRED FEATURES FOR AGRICULTURAL ROBOTS

In order to analyze which are the desirable features for robots to be used in agriculture and therefore which are the most promising lines for research as well as for engineering and product development it is informative to reconsider some of the relevant features of currently available robots and to understand how some of them have impaired the diffusion of robotic solutions in agriculture. One important aspect is that robots are in general quite expensive and sophisticated. They require man power with specific skills that are usually not available in agricultural workers and need specific infrastructures (power supply, systems for their movement throughout the crop, etc.). Particularly relevant is the fact that currently available robots developed for factory applications usually have precisions in the range of tenths or hundredths of millimeter. Such precision is about two to three order of magnitude greater than the precisions required in most agricultural operations where errors in the range of some millimeters are usually satisfactory. Remark that the higher is the required precision the higher is the weight of the robot, since its structure must be rigid to avoid deformations; and this ends up with higher power consumption and higher costs. From these simple considerations it follows a first very important guideline for research and product development related to robotic solutions in agriculture: it is important to design specific robots with mild precision (in the range of millimeters) and therefore much less expensive than typical industrial robots. Although the cost of robots for agricultural operations can be consistently reduced according to the previous guideline, however it cannot become negligible. To be appealing robotic solutions must offer a significant improvement in productivity with a reduction of costs that justifies. This obvious consideration leads to other two new guidelines. One concerns the type of cultures for which robotic solutions should be studied first. In fact, when automation intensive and highly remunerative cultures it'seasier to ensure an economic return that compensates higher investments. Remark that all cultures in greenhouses are of this kind and note also that greenhouses offer infrastructures (suchas power supply, artificial illumination, plinths to which rails can be hooked, etc.) and represent an environment that is usually partially structured or can be partially structured.

## 2.5 GUIDELINE FOR RESEARCH AND PRODUCT DEVELOPMENT

The robotic solutions in agriculture are then to focus on applications in greenhouses. The third guideline steaming from the need to ensure significant improvement over the standard use of human manpower indicates that valuable robotic solutions should be versatile and cover different tasks usually performed by human operators. This in order to reduce the amount of labor needed. If ideally all the tasks to be performed throughout the growth of one crop (planting, irrigating, fertilizing, spraying, weed control, etc.) could be managed by a robot, then human operators could just perform supervising tasks. The look for versatile multitask robots that ideally can manage all the operations needed in the production cycle of different crops. The concerns the development of new applications and tasks that can be performed only by a robot and are aimed to improve the crop quality, to improve safety and to reduce pollution and costs. A nice example of such a task is offered by precision spraying for cyclamens. This crop frequently needs treatment. Since the pests to be targeted live under the leaves, the spraying should occur under the leaf canopy in order to be really useful. The cyclamens should then be sprayed one by one, properly positioning the spraying nozzle. This indeed is practically impossible with human operators when the number of plants to beprocessed is huge as it is usually in dedicated enterprises.

# CHAPTER 3

# MECHANICAL SYSTEM

## 3.1 LAYER OF THE ROBOT

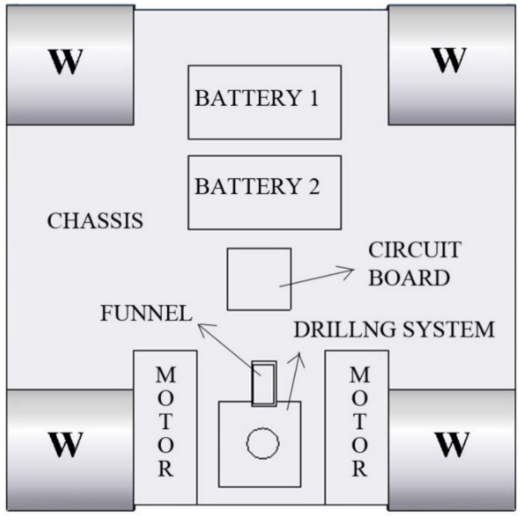


**Figure 3.1 Design Layout Of Robot**

SPECIFICATION

Robot size: 65 * 65cm

Wheels size: Diameter – 22cm, Width – 22cm

Chassis: Metal body

Motors: Two motors – front wheel driving

Drilling: Drilling motors with screw type rod

Seed dropper: Funnel and tube – 1.5cm Diameter

Seeds used: Coffee, Papaya Seed, Ground-Bean, Chickpea, Groundnut, Maize/Corn, Almond.

## 3.2 WHEELS

Wheels are robot legs that navigate around the ground, motorized wheels to propel and reach the destination. Wheels are easy to control the motion and there are lots of designs based on the field of use. Disadvantages of wheeled robots are that they cannot navigate well over obstacles, such as rocky terrain, sharp declines, or areas with low friction. Robots can have any number of wheels, but three wheels are sufficient for static and dynamic balance. Additional wheels can add to balance but when the terrain is not flat additional mechanisms will be required to keep all the wheels in the ground.

### 3.2.1 ROBOT TYPE BASED ON WHEELS

#### 3.2.1.1 Two Wheeled Robots

Two wheeled robots are harder to balance because they must keeping moving to maintain upright. The center of gravity of the robot body is kept below the axle and this is accomplished by mounting the batteries below the body. Two wheeled robots must keep moving to remain upright and they can do this by driving in the direction the robot is falling. To balance, the base of the robot must stay with under its center of gravity.

#### 3.2.1.2 Three or More Wheeled Robots

The wheels of the robot increase with the stability of the system. The balance of the robot is stable on all the wheels that the movement of the system is quick. But, the wheels have to turn with the same speed when the robot has to move forwards. Differences in speed between the left and right wheels in differentially steered robots cause the robot to move to the side instead of in a straight line.

### 3.2.3 ENGINEERING

#### 3.2.3.1 Center of Gravity

The important feature is to keep the center of mass between the wheels and as low as possible. The wheels itself is designed to place the center of gravity fall within each wheels.

#### 3.2.3.2 Materials

The need of selection of the right material is more important for better output of the dynamics of the vehicle. The materials of the wheels can be designed with wood, metal and rubber, but since the system should have to travel in field with more friction, rubber wheels are chosen.

#### 3.2.3.3 Measurement

The wheels of the system are designed flat and wide, that the wheels will not sink in the agricultural field. The diameter of the wheel is selected as 22cm and width is selected as 22cm. The design of the wheels is fabricated with the maximum diameter so that the system can move free in the agricultural field and over any type of obstacle.

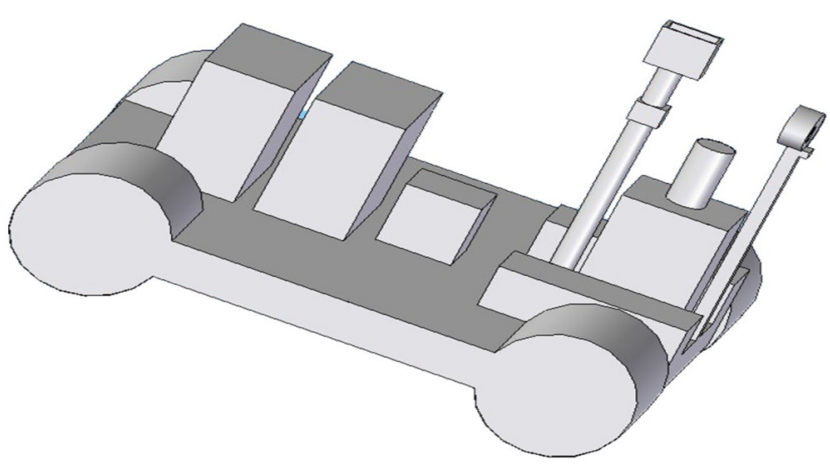

**Figure 3.2 Side View Of The Robot**

## 3.3 CHASSIS

A chassis consists of an internal framework and skeleton of the robot. A chassis is the under part of the vehicle, consisting of the frame on which the body is mounted. The robotics chassis system consists of driving motors, heavy battery, electronic circuits and other application devices.

### 3.3.1 Size and Design

The chassis is designed as the weight of the object can bare the load and compact with the system dynamics. The design of the chassis is made in the square for that the full size of the system falls within the limited size. The dimension of the chassis is fabricated as 65cmx65cm.

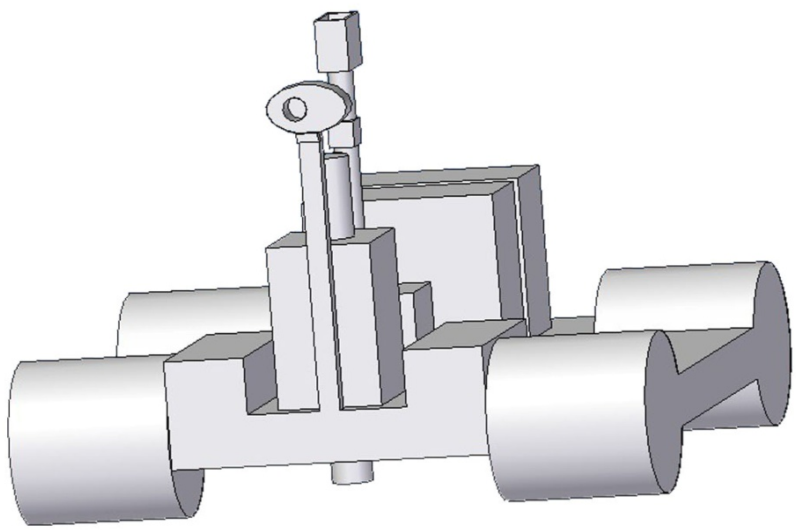

**Figure 3.3 Front View Of The Robot**

## 3.4 DRILLING MECHANISM

An easy way to bring a seed underground is to drill a hole or to strike a hole with a rod. In both solutions the seed would then be dropped into this gap. It is required to ensure that the hole does not fall together before the seed is placed. Hence the mechanism should be tested.

### 3.4.1 Types of Drilling Mechanism

#### 3.4.1.1 Hydraulic Method

Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically fluid or oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on one end by the cylinder bottom and the other end by the cylinder head where the piston rod comes out of the cylinder. In this, the drilling mechanism is slow and the position drilled is not accurate.

#### 3.4.1.2 Pneumatic Method

Pneumatics deals with the study and application of pressurized gas to produce mechanical motion. Pneumatic systems work when plumbed with compressed air or compressed inert gases. This is because a centrally located and electrically powered compressor, that powers cylinders and other pneumatic devices through solenoid valves, can provide motive power. In this mechanism is easy to access but cast is more and the compressor should be taken with the system all the time.

#### 3.4.1.3 Drilling Motor Method

The drilling motor works with high power so that is can penetrate in to the ground. The operating parameters include flow rate, bit rpm and torque of the motor, so that the efficiency of the drilling can be increased. The choice of using motors is mainly it is cheap, but the design of mounting and moving part is costly. The drilling bit of the motor should also be designed as the length of the bit depends on the height of the motor mounted over the ground. The measured drill bit length is about 18cm and it moves up and down when the process takes place. The design is made such a way that the drill bit never go near the ground when the robot is in move.

The reason for selecting the drilling motor method is the simplicity of the mechanism, as complexity can be reduced. The other method needs compressor cylinder and they are hard to carry with the vehicle all the time. Though the load current of the power will be more, they can be controlled with the proper regulator system.

### 3.5 SEED DROPPER

The seed dropper mechanism has to place the seeds at the specified position. The usage of the principle depends on the seed type and the system can be designed by dropping seed on the ground, to be slightly covered with soil or to be under ground in order to germinate.

#### 3.5.1 Property of Seed

The survey of the seeds helps to select the better mechanism for the particular seeds.

**Table 3.1 Properties of seed**

| S.no | BOTANICAL NAME | LOCAL NAME | SHAPE | SIZE |
|---|---|---|---|---|
| 1 | Coffee Arabica | Coffee | Bean Shape | About 11mmx6mm |
| 2 | Carica Papaya | Papaya Seed | Spherical | About 2mm In Diameter |
| 3 | Vigna Subterranea | Ground-Bean | Ellipsoid | About 10x4mm |
| 4 | Cicer Arietinum | Chickpea | Chick Head Shape | About 4.5mm In Diameter |
| 5 | Arachis Hypogaea | Groundnut | Ellipsoid | About 10x6mm |
| 6 | Zea Mays | Maize/Corn | Corn Shape | About 6x4mm |

| | | | | |
|---|---|---|---|---|
| 7 | Prunus Dulcis | Almond | Almond Shape | About 14x8mm |

## 3.6 TYPES OF SEED SOWING METHODS

### 3.6.1 Air Pressure

The air pressure can be used to create a little hole in which the seed is shot into. This requires a strong air pressure source and might fail if the ground is too hard. Another risk would be that seeds already placed nearby could be displaced by the pressure exhaust or by material being blown away.

### 3.6.2 Gravity

Gravity would be the simplest proposition as it does not require a complex mechanism, but it is only suitable for seeds that has regular shape and has mass to be dragged by gravity. The seed slides with the force of gravity and fall in the drilled hole.

### 3.6.3 Engineering of Seed Dropper

The design is done by a simple funnel method where the seeds are placed in the funnel. And by gravity method, the seeds are made to fall in the ground. The tube is placed through the path that the seed slides. The diameter of the tube is selected according to the selection of the seed. The servo is used to open and close mechanism with the specified time for the seeds to drop.The main reason for choosing these principles is their simplicity and cost-effectiveness.

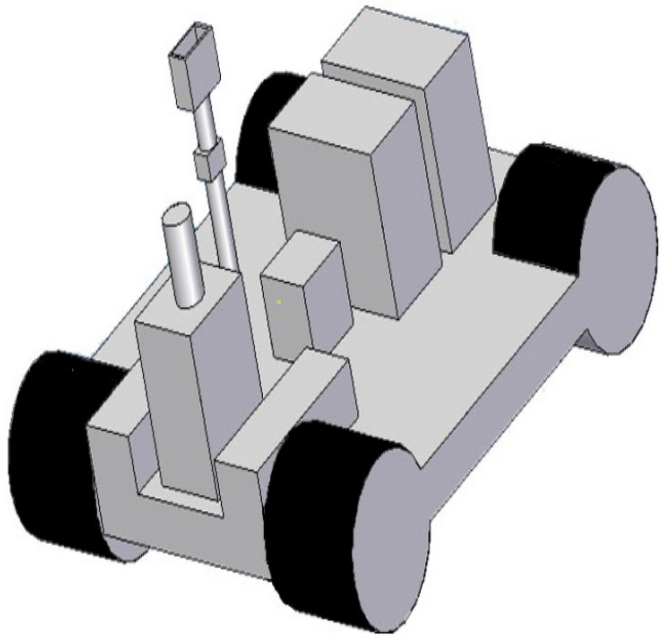

**Figure 3.4 Structure View of Robot**

## 3.7 VEHICLE DRIVING

The type of robotic driving is decided on the design of system and the motors used. A differential wheel drive is the most basic drive, which consists of motors on each wheel or motors in parallel wheels that can be driven independently. This is the most commonly used form of locomotion system used in robots, as it is simple and easy to implement.

### 3.7.1 Type in Differential Wheel Driving

#### 3.7.1.1 Back Wheel Driving

In this driving, the motors are coupled at the back wheels and front wheels are free to move. According to the Newton theory, the system moves with the easy forward movement as the free wheels is pushed up. The load of the system is less and the movement is easier in turning. Since the front wheel lift in fast motion there is a possible of topple over situation by losing the center of gravity.

**3.7.1.2 Front Wheel Driving**

In this driving, the motors are coupled at the front wheels and back wheels are free move. According to the Newton theory, the system is more stable because of the system moves with the force of the vehicle pulling down-wards and frictional force is more with increasing in the gravity force. As the other part, due to the more down-ward pull the load of the motors is more compared with the back wheel driving.

The agriculture application is required with stable movement, so the robotics system is designed with the front wheel drive. The moving force of the system is the most important regarding this heavy vehicle system, in this condition the front wheel driving suits the requirement. It has free moving wheels in the back and at front the motors are coupled with wheels.

# CHAPTER 4

# ELECTRICAL SYSTEM

## 4.1 BLOCK DIAGRAM

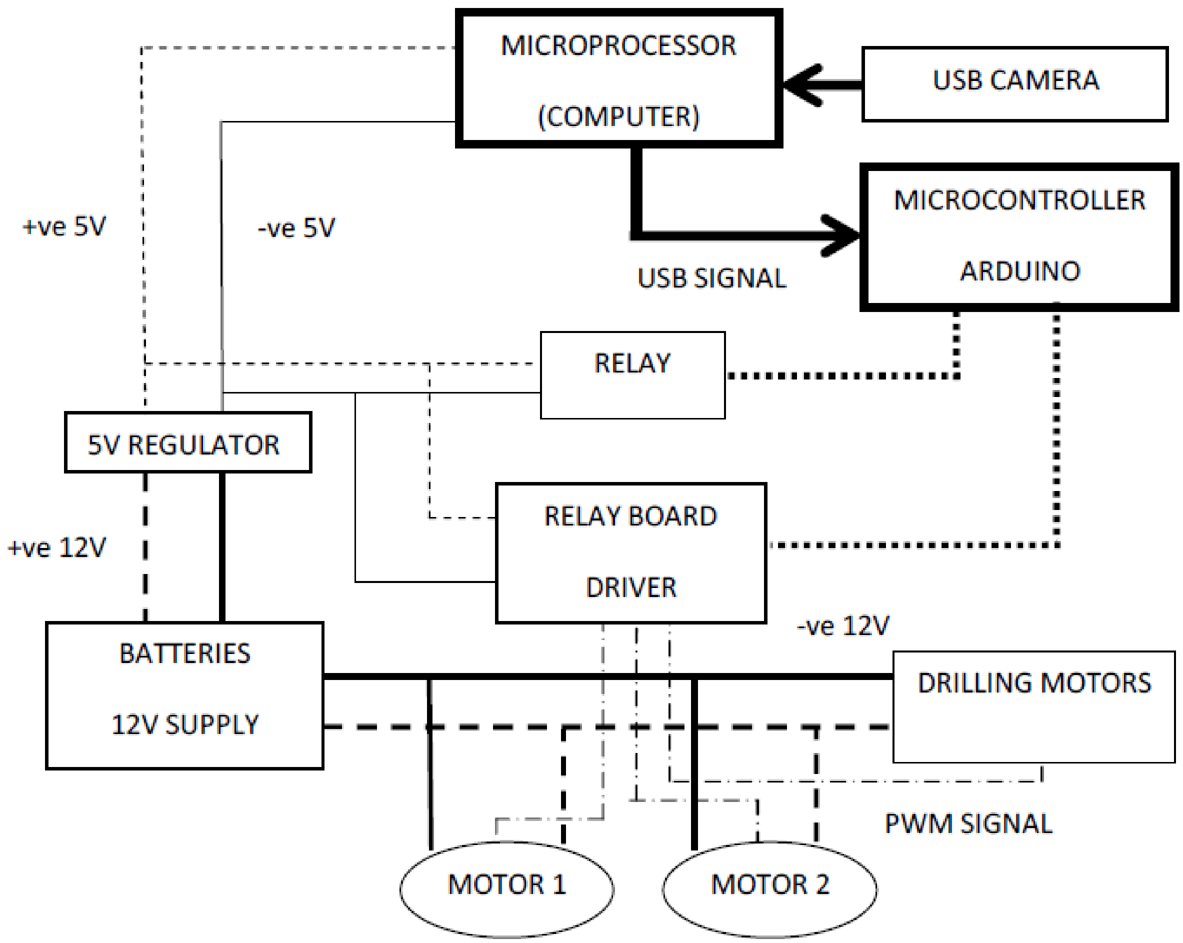


**Figure 4.1 Signal Block Diagram**

## 4.2 WHEEL MOTORS

Wheels motors are the most important component for the mobile robot.DC-motors are very easy to use for robotics and dependent on the gearing available. DC-motors are made much more effective if they have an efficient gear ratio for a particular task. Motors used in robots need torque over top speed and there are several different types of motors. Each motor type has several advantages as well as disadvantages depending on a particular robots design.

The control of a DC motor can be split into two parts: speed and direction.

### 4.2.1 Direction

The direction spin of the motor decides the direction of navigation of the vehicle. Thus the robotics control will be accurate and the movement of the vehicle is dynamically stable.

### 4.2.2 Speed

Speed of the motor is important in control system and determines the vehicle motion. PWM method is used to control the speed of the motor, which is controlled by the microcontroller.

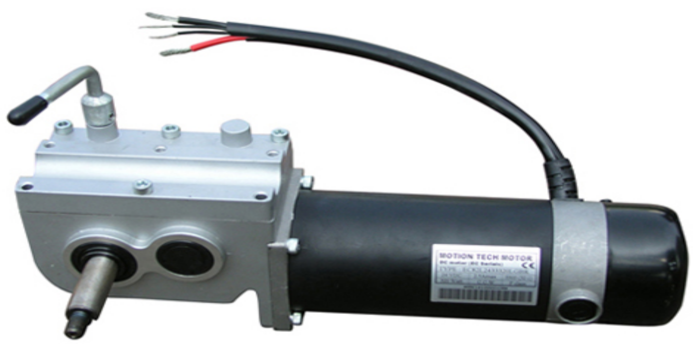

**Figure 4.2 DC Motor**

### 4.2.3 Specification

- Motor Size: 35cm
- Power: 100W
- Poles: 2
- Power supply: 12V DC
- Speed: 300 rpm

## 4.3 SERVO MOTORS

A servo mechanism is an automatic device that uses error-sensing negative feedback to correct the performance of a mechanism and is defined by its function. It usually includes an in-built encoder. The term correctly applies only to systems where the feedback or error-correction signals help control mechanical position, speed or other parameters. For example, an automotive power window control is not a servomechanism, as there is no automatic feedback that controls position—the operator does this by observation.

### 4.3.1 Position Control

A common type of servo provides position control. Servos are commonly electrical or partially electronic in nature, using an electric motor as the primary means of creating mechanical force. Other types of servos use hydraulics, pneumatics, or magnetic principles. Servos operate on the principle of negative feedback, where the control input is compared to the actual position of the mechanical system as measured by some sort of transducer at the output and used to drive the system in the direction necessary to reduce or eliminate the error. This procedure is one widely used application of control theory.

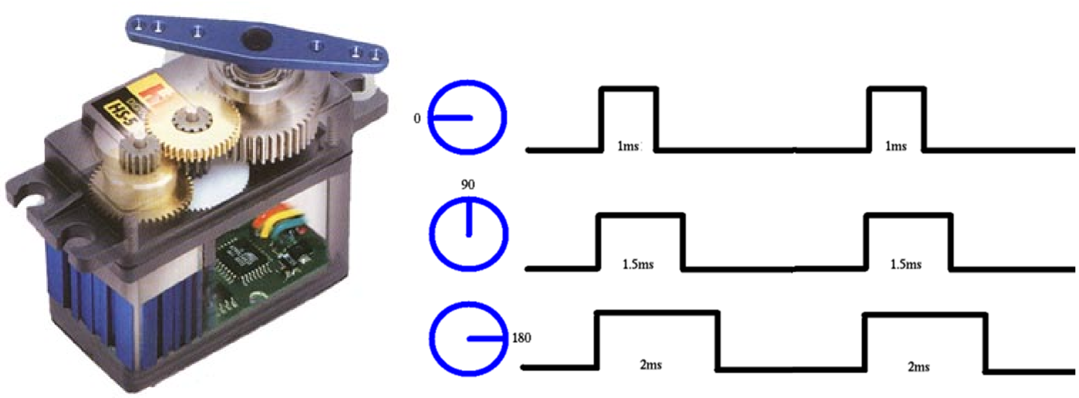


**Figure 4.3 Servo And Timing Diagram**

### 4.4 DRILLING MOTORS

The drilling motor works with high power so that is can penetrate in to the ground. The operating parameters include flow rate, bit rpm and torque of the motor, so that the efficiency of the drilling can be increased. The choice of using motors is mainly it is cheap, but the design of mounting and moving part is costly. The drilling bit of the motor should also be designed as the length of the bit depends on the height of the motor mounted over the ground. The design is made such a way that the drill bit never go near the ground when the robot is in move.

**Figure 4.5 Drilling Motors**

#### 4.4.1 Specification

- Motor Size: 17cm
- Power: 75W
- Poles: 2
- Power supply: 12V DC
- Speed: 800 rpm

## 4.5 SOURCE: TESTED BATTERY

### 4.5.1 Lithium Polymer Batteries

Lithium polymer batteries (LiPo) are rechargeable (secondary cell) batteries. LiPo batteries are usually composed of several identical secondary cells in parallel to increase the discharge current capability. The voltage of a Li-poly cell varies from about 2.7 V (discharged) to about 4.23 V (fully charged), and Li-poly cells have to be protected from overcharge by limiting the applied voltage to no more than 4.235 V per cell used in a series combination.

### 4.5.2 Nickel–Cadmium Battery

The nickel–cadmium battery (NiCd battery) is a type of rechargeable battery using nickel oxide hydroxide and metallic cadmium as electrodes. Ni–Cd cells have a nominal cell potential of 1.2 volts (V). This is lower than the 1.5 V of alkaline and zinc–carbon primary cells, and consequently they are not appropriate as a replacement in all applications. However, the 1.5 V of a primary alkaline cell refers to its initial, rather than average, voltage. Unlike alkaline and zinc–carbon primary cells, a Ni–Cd cell's terminal voltage only changes a little as it discharges.

### 4.5.3 Lead–Acid Battery

The lead–acid battery is the oldest type of rechargeable battery. The battery has a very low energy-to-weight ratio and a low energy-to-volume ratio. It has the ability to supply high surge currents, so that the load of the power is distributed equally.

**Table 4.1 Tested Lead-acid battery**

| Part Number | Manufacturer | Voltage, V | Capacity, A·h |
|---|---|---|---|
| NB12-18HR | National Battery | 12 | 18.0 |
| SP12-18HR | Sigmas Battery | 12 | 18.0 |
| UB12180 | Universal Power Group | 12 | 18.0 |

### 4.5.4 Using Battery

Two 12V Lead-acid batteries are used by the vehicle for the power supply and are connected in series to draw more current for the wheel motors. The heavy batteries are placed in the back centre vertically supported so that the leakage of the battery is avoided.


**Figure 4.6 Battery**

## 4.6 CAMERA

A webcam is a video camera that feeds or streams its image in real time to or through a computer. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and email as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera (which uses a direct connection using Ethernet or Wi-Fi), a webcam is generally connected by a USB cable, FireWire cable, or similar cable, or built into computer hardware, such as laptops. Their most popular use is the establishment of video links, permitting computers to act as videophones or videoconference stations.

### 4.6.1 Used Camera

**Figure 4.7 Logitech HD Webcam C270**

Logitech HD Webcam C270 is the used, as the HD USB camera has high resolution and easily accessible with all type of operating system. This cam works simple and also include security surveillance, computer vision, video broadcasting, and for recording social videos. Webcams are known for their low manufacturing cost and flexibility, making them the lowest cost form of video telephony.

### 4.6.2 Features

- Dimensions:3 x 8.2 x 6 inches
- Fluid HD 720p video recording and video calling in 16:9 widescreen
- Crisp 3 MP photos
- Auto light correction and built-in noise-cancelling mic make video calls look and sound great
- Works with both Windows-based PCs and Linux system

## 4.7 RELAY BOARD

Relay board are used for the switching and control of heavy loaded motors. The direction of the motors can be changed with 8 channel relay board where each channel represents each direction.

### 4.7.1 Features

This relay module is 5V active low. It is an 8-channel relay interface board, which can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM, PLC, etc. It is also able to control various appliances and other equipment's with large current. Relay output maximum contact is AC250V 10A and DC30V 10A. Standard interface can be directly connected with microcontrollers. Red working status indicator lights are conducive to the safe use. Widely used for all MCU control, industrial sector, PLC control, smart home control.

### 4.7.2 Specifications:

Working voltage: 5V

Channel: 8 channel

Item size: 13.4 * 5.3 * 1.7cm

Item weight: 116g

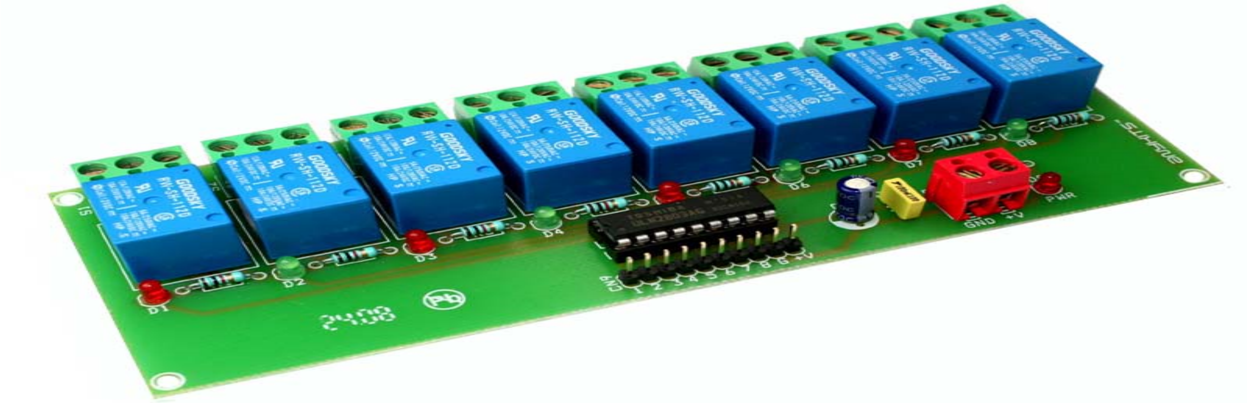

**Figure 4.8 Relay Board**

# CHAPTER 5

# ELECTRONIC SYSTEM

## 5.1 MICROPROCESSOR

### 5.1.1 BEAGLEBOARD

The BeagleBoard is a low-power, open-source, hardwaresingle-board computer produced by Texas Instruments. The BeagleBoard was designed with open source software development, and as a way of demonstrating the Texas Instrument's OMAP3530system-on-a-chip. The board was developed by a small team of engineers as an educational board that could be used in colleges around the world to teach open source hardware and open source software capabilities.

The BeagleBoard measures approximately 75 by 75 mm and has all the functionality of a basic computer. The OMAP3530 includes an ARM Cortex-A8 CPU (which can run Linux, FreeBSD,OpenBSD, RISC OS, or Symbian; Android is also being ported), a TMS320C64x+DSP for accelerated video and audio decoding, and an Imagination Technologies PowerVR SGX530GPU to provide accelerated 2D and 3D rendering that supports OpenGL ES 2.0. Video out is provided through separate S-Video and HDMI connections. A single SD/MMC card slot supporting SDIO, a USB On-The-Go port, an RS-232 serial connection, a JTAG connection, and two stereo 3.5 mm jacks for audio in/out are provided.

Built-in storage and memory are provided through a PoP chip that includes 256 MB of NAND flash memory and 256 MB of RAM (128 MB on earlier models).The board uses up to 2 W of power and can be powered from the USB connector, or a separate 5 V power supply. Because of the low power consumption, no additional cooling or heat sinks are required.

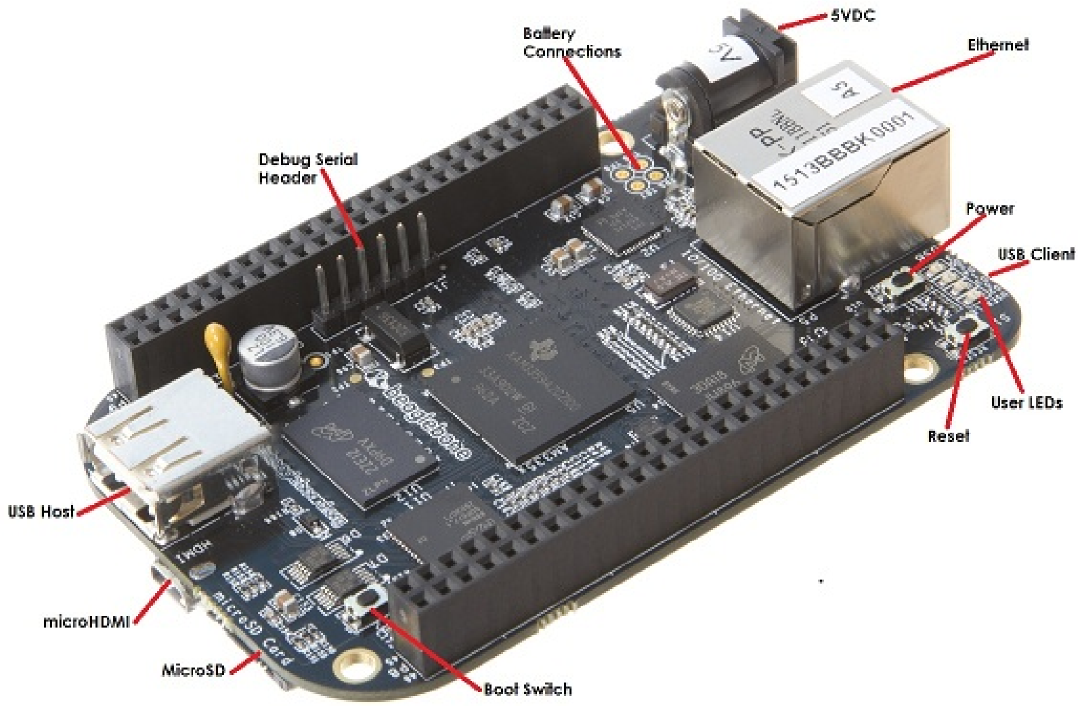


**Figure 5.1 Beagleboard**

### 5.1.2 RASPBERRY PI

The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, VideoCore IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and persistent storage.

The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C/C++, Java and Perl.

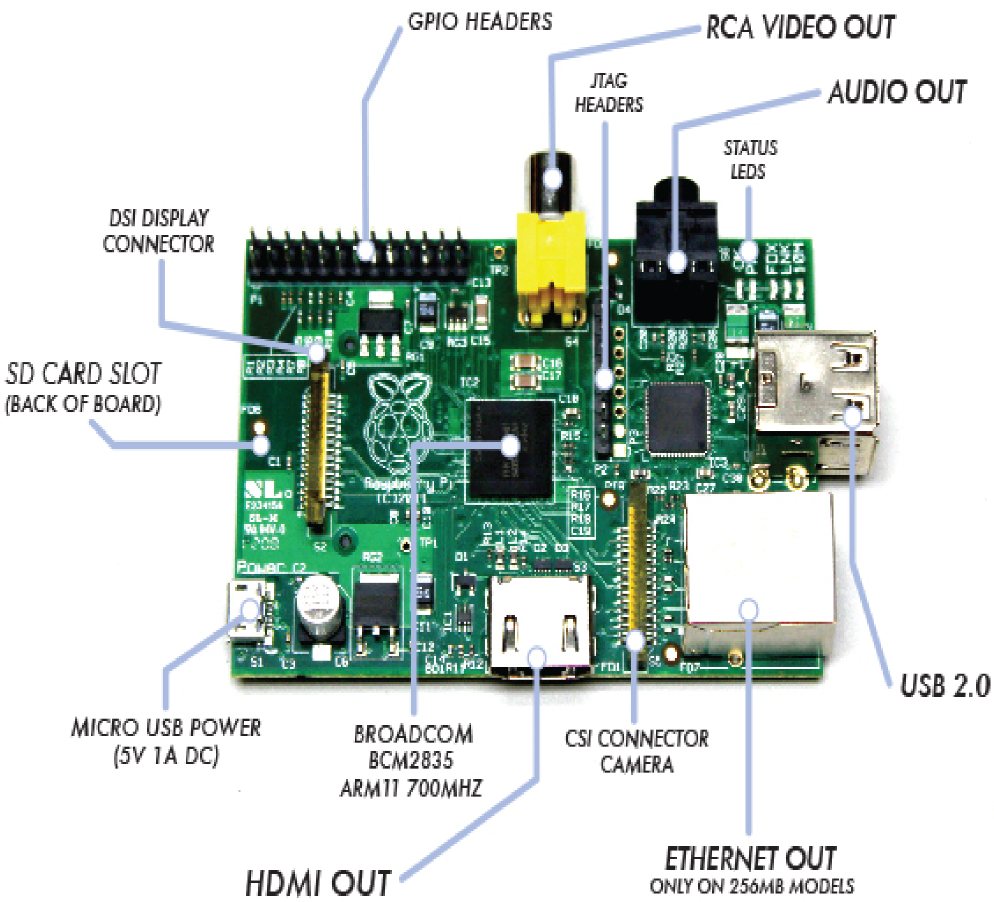


**Figure 5.2 Raspberry Pi**

Raspberry Pi is the selected board as the use of the microprocessor is very easy and the software of the board is easily loaded. The cost of the board is cheap and power conception is very less compared with Beagleboard. The image processing section is very fast in Raspberry Pi board.

**Table 5.1 Hardware Specification of Raspberry Pi**

| | Model A | Model B |
|---|---|---|
| **SoC:** | Broadcom BCM2835 (CPU, GPU, DSP, SDRAM, and single USB port) | |
| **CPU:** | 700 MHz ARM1176JZF-S core (ARM11 family, ARMv6 instruction set) | |
| **GPU:** | Broadcom VideoCore IV @ 250 MHz OpenGL ES 2.0 (24 GFLOPS) MPEG-2 and VC-1 (with license), 1080p30 h.264/MPEG-4 AVC high-profile decoder and encoder | |
| **Memory (SDRAM):** | 256 MB (shared with GPU) | 512 MB (shared with GPU) |
| **USB 2.0 ports:** | 1 (direct from BCM2835 chip) | 2 (via the built in integrated 3-port USB hub) |
| **Video input:** | A CSI input connector allows for the connection of a RPF designed camera module | |
| **Video outputs:** | Composite RCA (PAL and NTSC), HDMI (rev 1.3 & 1.4), raw LCD Panels via DSI 14 HDMI resolutions from 640×350 to 1920×1200 plus various PAL and NTSC standards. | |
| **Audio outputs:** | 3.5 mm jack, HDMI, and, as of revision 2 boards, I²S audio (also potentially for audio input) | |
| **Onboard storage:** | SD / MMC / SDIO card slot (3.3 V card power support only) | |
| **Onboard network:** | None | 10/100 Mbit/s Ethernet (8P8C) USB adapter on the third port of the USB hub |
| **Low-level peripherals:** | 8 × GPIO, UART, I²C bus, SPI bus with two chip selects, I²S audio +3.3 V +5 V, ground | |
| **Power ratings:** | 300 mA (1.5 W) | 700 mA (3.5 W) |
| **Power source:** | 5 V via MicroUSB or GPIO header | |
| **Size:** | 85.60 mm × 53.98 mm (3.370 in × 2.125 in) | |
| **Weight:** | 45 g (1.6 oz) | |
| **Operating systems:** | Arch Linux ARM,Debian GNU/Linux, Gentoo, Fedora, FreeBSD, NetBSD, Plan 9, Raspbian OS, RISC OS, Slackware Linux | |

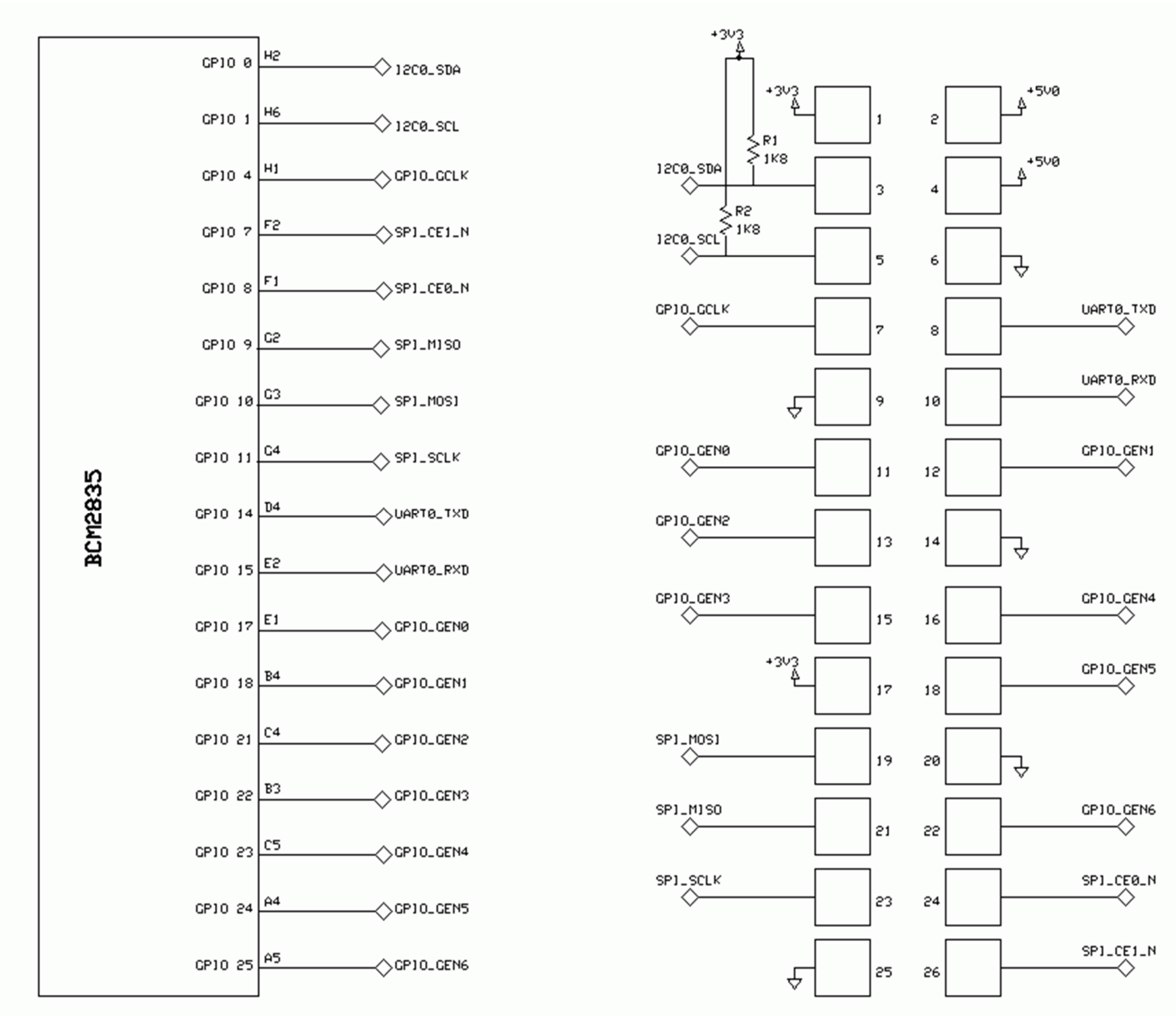


**Figure 5.3 Raspberry Pi Pin Diagram**

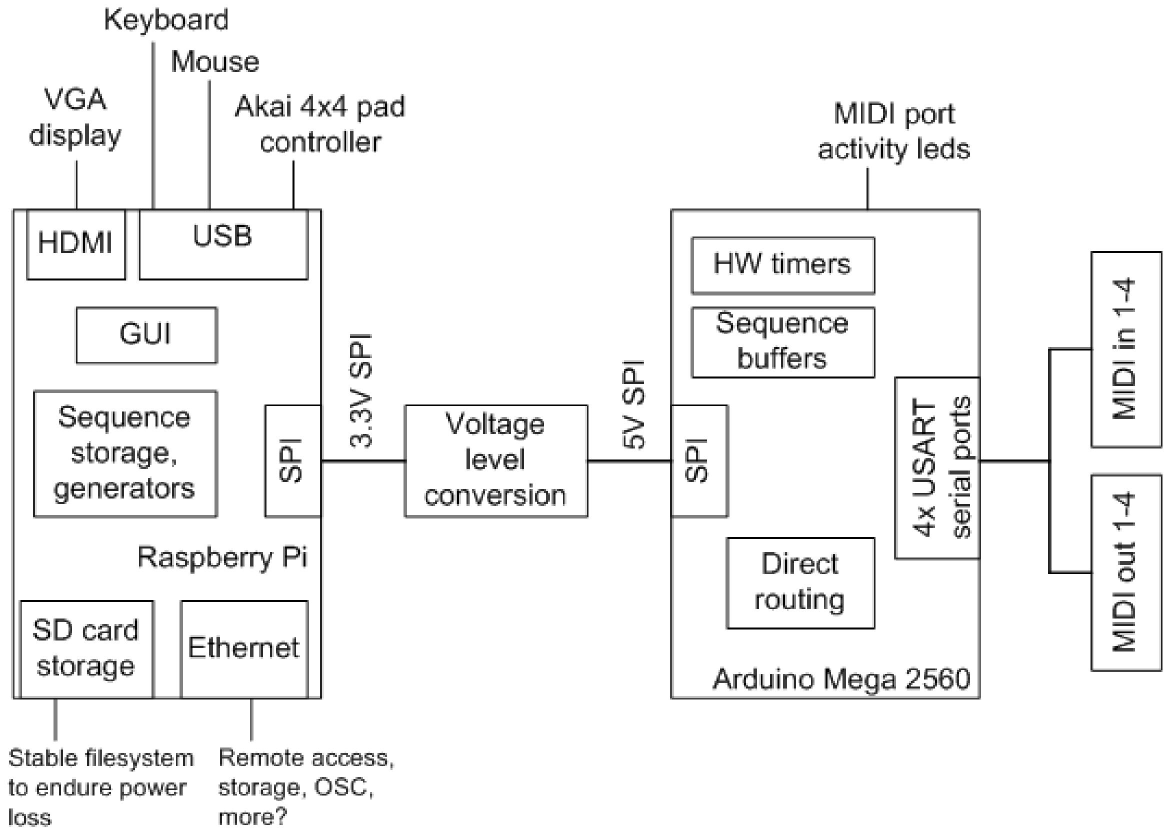


**Figure 5.4 Raspberry Pi Architecture**

**Architecture of Raspberry Pi**

As is standard practice, the standard BCM2835 Linux kernel provides a contiguous mapping over the whole of available RAM at the top of memory. The kernel is configured for a 1GB/3GB split between kernel and user-space memory.

The split between ARM and GPU memory is selected by installing one of the supplied start*.elf files as start.elf in the FAT32 boot partition of the SD card. The minimum amount of memory which can be given to the GPU is 32MB, but that will restrict the multimedia performance; for example, 32MB does not provide enough buffering for the GPU to do 1080p30 video decoding.

Virtual addresses in kernel mode will range between 0xC0000000 and 0xEFFFFFFF.Virtual addresses in user mode (i.e. seen by processes running in ARM Linux) will range between 0x00000000 and 0xBFFFFFFF.

Peripherals (at physical address 0x20000000 on) are mapped into the kernel virtual address space starting at address 0xF2000000. Thus a peripheral advertised here at bus address 0x7Ennnnnn is available in the ARM kenel at virtual address 0xF2nnnnnn

Physical addresses start at 0x00000000 for RAM.

• The ARM section of the RAM starts at 0x00000000.

• The VideoCore section of the RAM is mapped in only if the system is configured to support a memory mapped display (this is the common case).

The VideoCore MMU maps the ARM physical address space to the bus address space seen by VideoCore (and VideoCore peripherals). The bus addresses for RAM are set up to map onto the uncached1 bus address range on the VideoCore starting at 0xC0000000. Physical addresses range from 0x20000000 to 0x20FFFFFF for peripherals. The bus addresses for peripherals are set up to map onto the peripheral bus address range starting at 0x7E000000. Thus a peripheral advertised here at bus address 0x7Ennnnnn is available at physical address 0x20nnnnnn.

The peripheral addresses specified in this document are bus addresses**.**

Software directly accessing peripherals must translate these addresses into physical or virtual addresses, as described above. Software accessing peripherals using the DMA engines must use bus addresses. 1 BCM2835 provides a 128KB system L2 cache, which is used primarily by the GPU.

## 5.2 MICROCONTROLLER

### 5.2.1 MSP430

The MSP430 can be used for low powered embedded devices. The electric current drawn in idle mode can be less than 1 µA. The top CPU speed is 25 MHz. It can be throttled back for lower power consumption. The MSP430 also uses six different low-power modes, which can disable unneeded clocks and CPU.

Additionally, the MSP430 is capable of wake-up times below 1 microsecond, allowing the microcontroller to stay in sleep mode longer, minimizing its average current consumption. The device comes in a variety of configurations featuring the usual peripherals: internal oscillator, timer including PWM, watchdog, USART, SPI, $I^2C$, 10/12/14/16-bit ADCs, and brownout reset circuitry. Some less usual peripheral options include comparators (that can be used with the timers to do simple ADC), on-chip op-amps for signal conditioning, 12-bit DAC, LCD driver, hardware multiplier, USB, and DMA for ADC results.

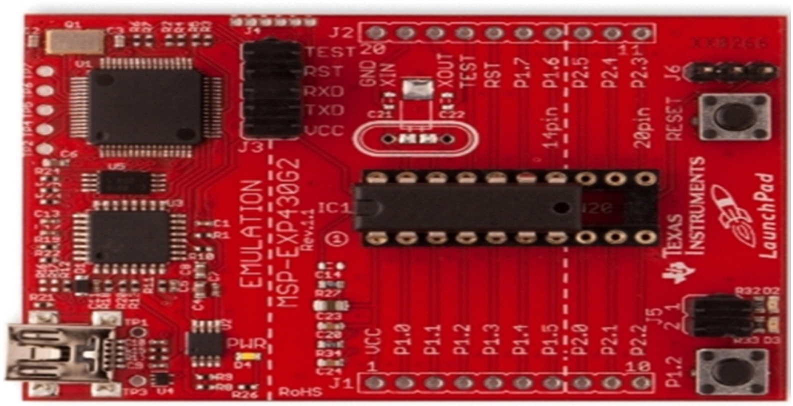


**Figure 5.5 MSP430 board**

Apart from some older EPROM (MSP430E3xx) and high volume mask ROM (MSP430Cxxx) versions, all of the devices are in-system programmable via JTAG (full four-wire or Spy-Bi-Wire) or a built in bootstrap loader (BSL) using RS-232.

There are, however, limitations that preclude its use in more complex embedded systems. The MSP430 does not have an external memory bus, so it is limited to on-chip memory (up to 256 KB flash memory and 16 KB RAM) which might be too small for applications that require large buffers or data tables. Also, although it has a DMA controller, it is very difficult to use it to move data off the chip due to a lack of a DMA output strobe.

### 5.2.2 ARDUINO

Arduino is a single-board microcontroller, intended to make the application of interactive objects or environments more accessible. The hardware consists of an open-source hardware board designed around an 8-bit AtmelAVR microcontroller, or a 32-bit Atmel ARM. Pre-programmed into the on-board microcontroller chip is a boot loader that allows uploading programs into the microcontroller memory without needing a chip (device) programmer.

#### 5.2.2.1 Hardware

An Arduino board consists of an Atmel 8-bit AVR microcontroller with complementary components to facilitate programming and incorporation into other circuits. An important aspect of the Arduino is the standard way that connectors are exposed, allowing the CPU board to be connected to a variety of interchangeable add-on modules known as shields. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²Cserial bus, allowing many shields to be stacked and used in parallel. A handful of other processors have been used by Arduino compatibles.

**Table 5.2 List of Arduino Board**

| Name | Processor | CPU Speed | Analog In/Out | Digital IO/PWM | Flash [KB] | USB | UART |
|---|---|---|---|---|---|---|---|
| **Uno** | ATmega328 | 16 Mhz | 6/0 | 14/6 | 32 | 1 | 1 |
| **Due** | AT91SAM3X8E | 84 Mhz | 12/2 | 54/12 | 512 | 2 | 4 |
| **Leonardo** | ATmega32u4 | 16 Mhz | 12/0 | 20/7 | 32 | 1 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mega 2560** | ATmega2560 | 16 Mhz | 16/0 | 54/15 | 256 | 1 | 4 |
| **Mega ADK** | ATmega2560 | 16 Mhz | 16/0 | 54/15 | 256 | 1 | 4 |

Arduino boards include a 5 volt linear regulator and a 16 MHz crystal oscillator (or ceramic resonator in some variants), although some designs such as the LilyPad run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions. An Arduino's microcontroller is a pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer.

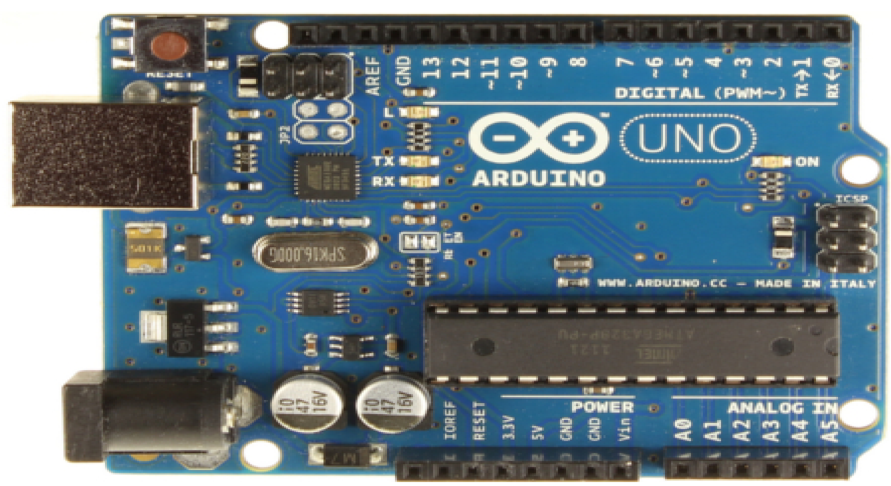


**Figure 5.6 Arduino**

Arduino board has been selected as the boot loarder is easy to use. The software is written and compiled easily compared to other microcontroller. The communication with the microprocessor can be interfaced easily with Arduino and the level of code is less complicated.

**Table 5.3 Arduino board specification**

| | |
|---|---|
| Microcontroller | ATmega328 |
| Operating Voltage | 5V |
| Input Voltage (recommended) | 7-12V |
| Input Voltage (limits) | 6-20V |
| Digital I/O Pins | 14 (of which 6 provide PWM output) |
| Analog Input Pins | 6 |
| DC Current per I/O Pin | 40 mA |
| DC Current for 3.3V Pin | 50 Ma |
| Flash Memory | 32 KB (ATmega328) of which 0.5 KB used by bootloader |
| SRAM | 2 KB (ATmega328) |
| EEPROM | 1 KB (ATmega328) |
| Clock Speed | 16 MHz |

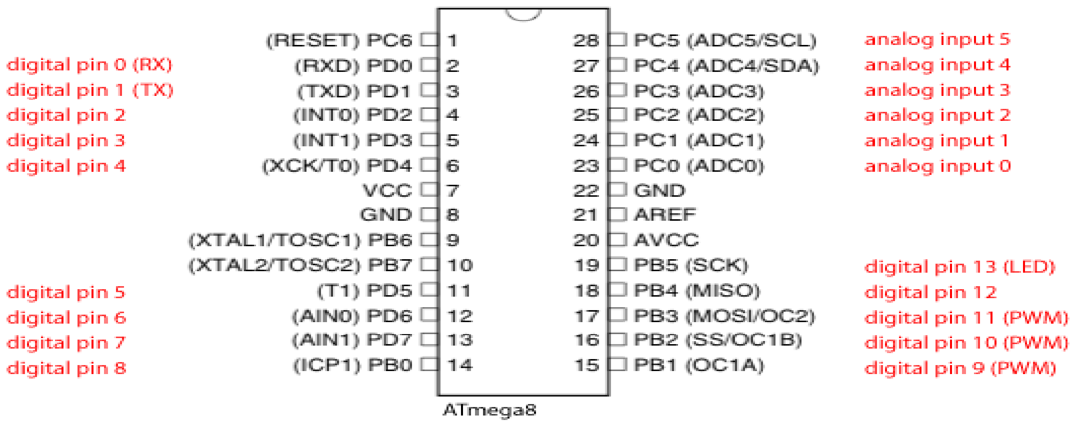


**Figure 5.7 Arduino Pin Diagram**

**Architecture of Arduino**

The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. The ATmega8 provides the following features: 8 Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 512 bytes of EEPROM, 1 Kbyte of SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte oriented Two wire Serial Interface, a 6-channel ADC (eight channels in TQFP and QFN/MLF packages) with 10-bit accuracy, a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and five software selectable power saving modes.

The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Powerdown mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next Interrupt or Hardware Reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption. The device is manufactured using Atmel's high density non-volatile memory technology. The Flash Program memory can be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash Section will continue to run while the Application Flash Section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega8 is a powerful microcontroller that provides a highly-flexible and cost-effective solution to many embedded control applications.

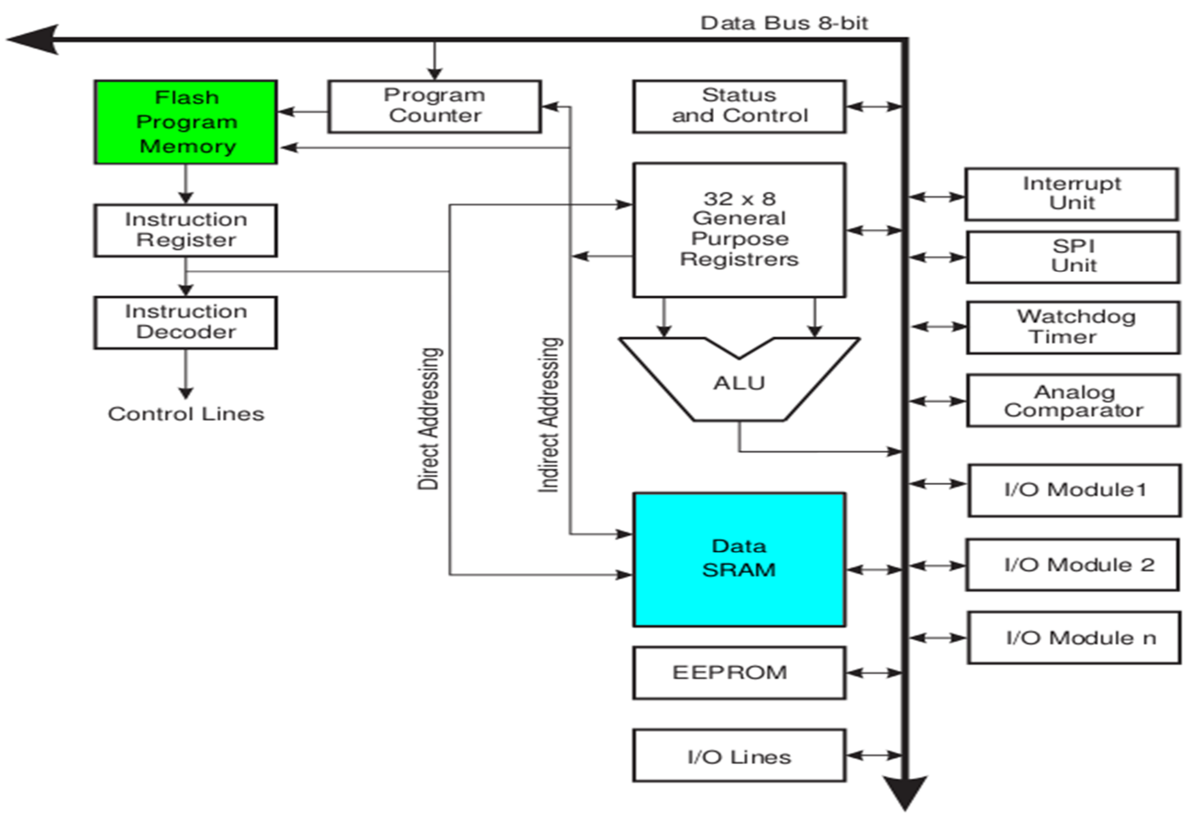


**Figure 5.8 Arduino Architecture**

The ATmega8 is supported with a full suite of program and system development tools, including C compilers, macro assemblers, program simulators, and evaluation kits. Typical values contained in this datasheet are based on simulations and characterization of other AVR microcontrollers manufactured on the same process technology. Minimum and Maximum values will be available after the device is characterized.

# CHAPTER 6

# SOFTWARE

## 6.1 FLOW CHARTS

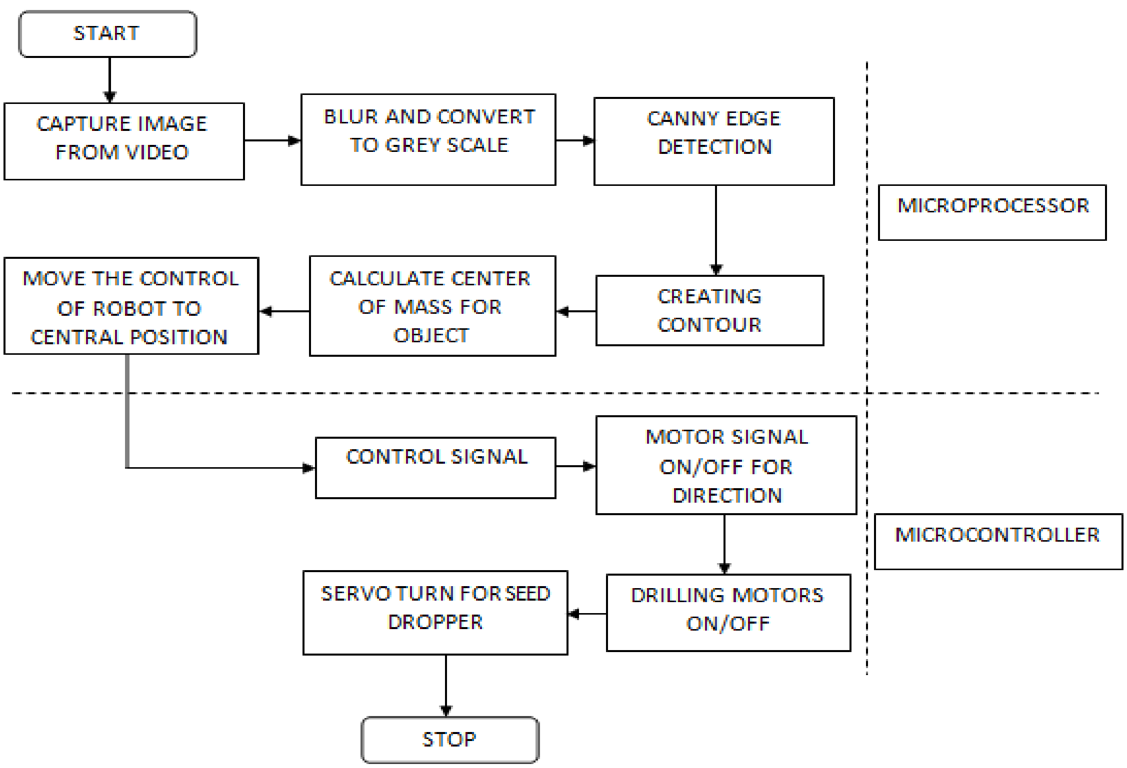


**Figure 6.1 Flow Chart Of The Process**

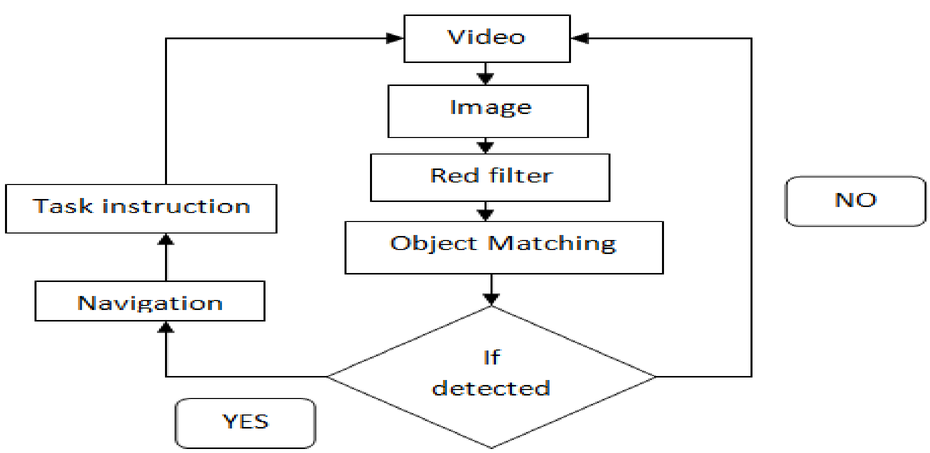


**Figure 6.2 Image Processing Flow Chart**

### 6.1.1ALGORITHM

Algorithm for flow chart fig 6.1

Step 1: Start by capturing video from the camera

Step 2: Getting the image from the video

Step 3: By using red filter image signals are captured

Step 4: Object is compare by using object matching unit

Step 5: If object detected the process continue further

Step 6: If object is not detected return back

Step 7: After detecting the navigation process start

Step 8: After navigate task to be done is proceed

Step 9: Stop the process after all task completed

Algorithm for flow chart fig 6.2

Step1: Start the program

Step2: Image is captured from the webcam

Step3: Image is convert into grey scale

Step4: Canny edge detection is done

Step5: Then center of mass of the object is calculated

Step6: will create the contour

Step7: After this the control will be passed to the motors of the robot

Step8: Motors will turn on/off based on the signals

Step9: Robot will move to the position

Step10: Drill motor will on servo will on seed will be dropped

Step11: Stop

**6.2 ARDUNIO IDE**

The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a "sketch".

Arduino programs are written in C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. Users only need define two functions to make a runnable cyclic executive program:

- setup(): a function run once at the start of a program that can initialize settings
- loop(): a function called repeatedly until the board powers off

It is a feature of most Arduino boards that they have an LED and load resistor connected between pin 13 and ground; a convenient feature for many simple tests. The previous code would not be seen by a standard C++ compiler as a valid program, so when the user clicks the "Upload to I/O board" button in the IDE, a copy of the code is written to a temporary file with an extra include header at the top and a very simple main() function at the bottom, to make it a valid C++ program. The Arduino IDE uses the GNU toolchain and AVR Libc to compile programs, and uses avrdude to upload programs to the board.

As the Arduino platform uses Atmel microcontrollers, Atmel's development environment, AVR Studio or the newer Atmel Studio, may also be used to develop software for the Arduino.

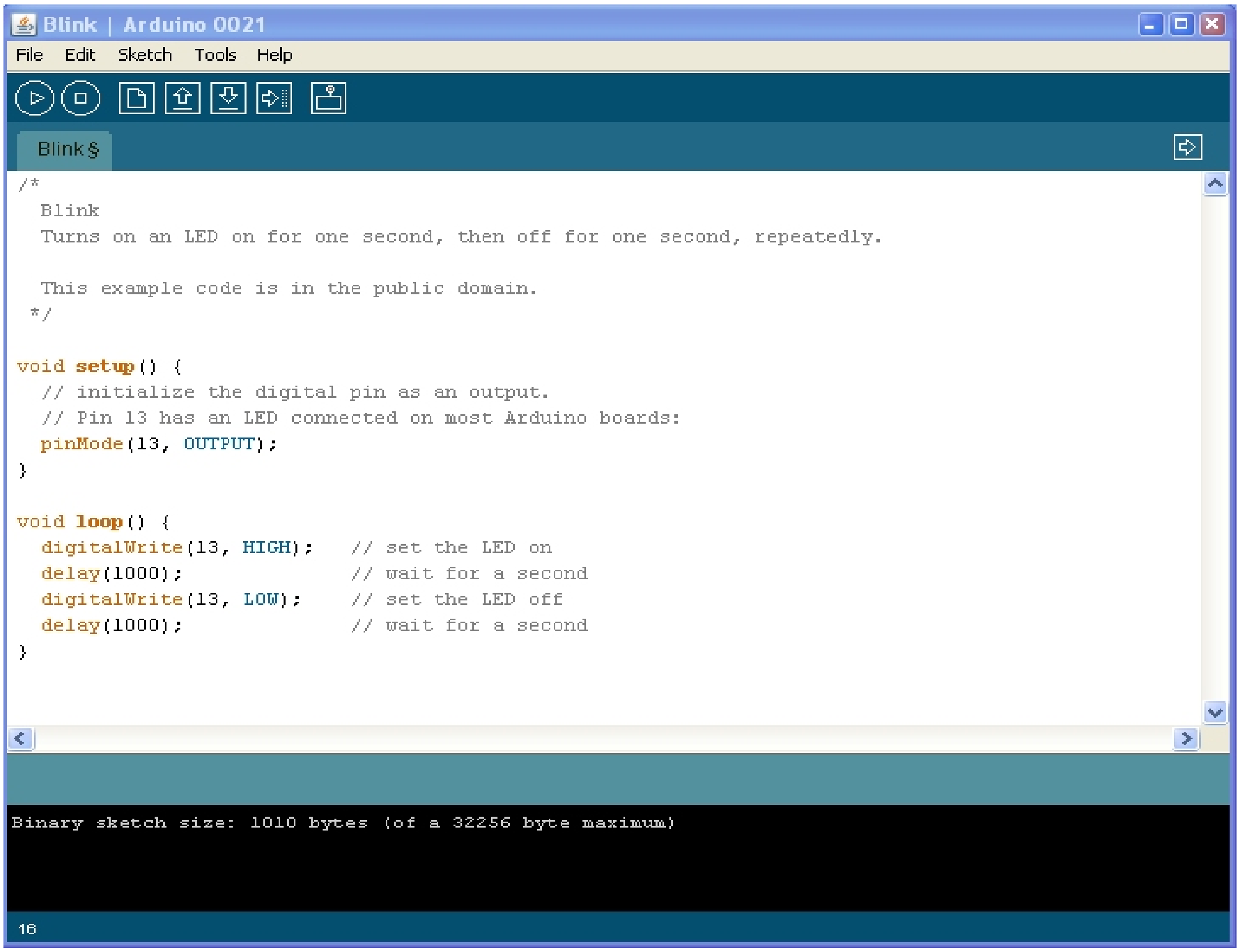


**Figure 6.3 Arduino IDE**

### 6.3 RASPBERRY PI SOFTWARE

The Raspberry Pi uses Linux kernel-based operating systems. The GPU hardware is accessed via a firmware image which is loaded into the GPU at boot time from the SD-card. The firmware image is known as the binary blob, while the associated ARM coded Linux drivers were initially closed source. This part of the driver code was later released, however much of the actual driver work is done using the closed source GPU code. Application software uses calls to closed source run-time libraries (Open Max, OpenGL ES or open VG) which in turn calls an open source driver inside the Linux kernel, which then calls the closed source Videocore IV GPU driver code. The API of the kernel driver is specific for these closed libraries. Video applications use OpenMAX, 3D applications use OpenGL ES and 2D applications use OpenVG which both in turn use EGL. OpenMAX and EGL use the open source kernel driver in turn.

#### 6.3.1 Raspbian

After cycling through several recommendations since just before the hardware was first made available, the Raspberry Pi Foundation created the New Out Of Box System (NOOBS) installer, and suggests using it to install the Debian-derived Raspbian. The Foundation intends to create an application store website for people to exchange programs.

Raspbian is a Debian-based free operating system optimized for the Raspberry Pi hardware. It is the current recommended system, although it is still in development. It is free software and maintained independently of the Raspberry Pi Foundation. It is based on ARM hard-float (armhf)-Debian 7 'Wheezy' architecture port with the LXDE desktop environment, but optimized for the ARMv6 instruction set of the Raspberry Pi, which lacks Jazelle RCT/ThumbEE, VFPv3 and the NEON SIMD extension. It provides some available deb software packages, pre-compiled software bundles. A minimum size of 2 GB SD card is required for Raspbian, but a 4 GB SD card or above is recommended. The downloaded Raspbian Wheezy image file has to be unzipped and then written to a suitable SD card, formatting it for use.

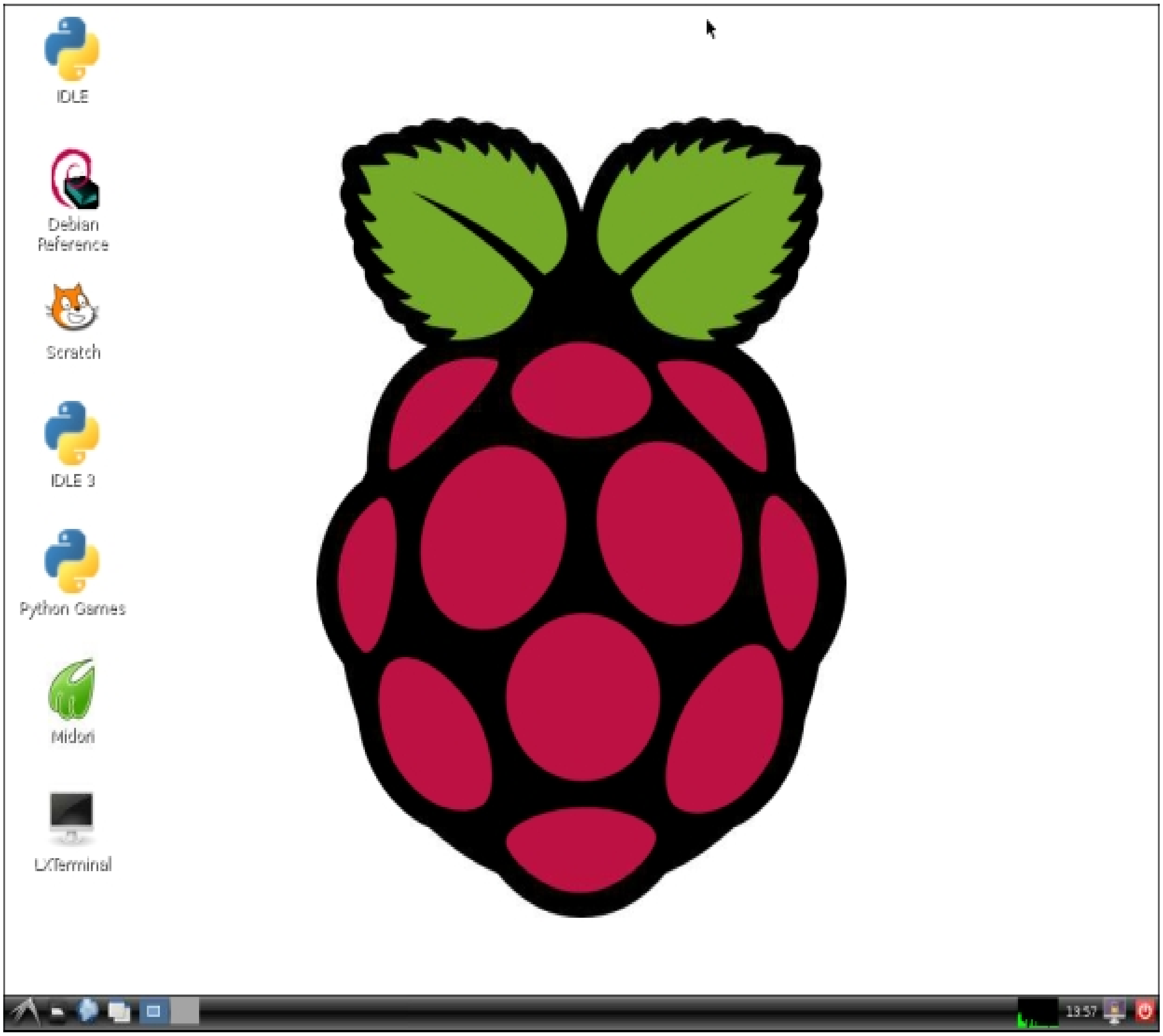


**Figure 6.4 Raspberry Pi Desktop**

### 6.4 OPENCV

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision, developed by Intel, and now supported by Willow Garage and Itseez. It is free for use under the open source BSD license. The library is cross-platform. It focuses mainly on real-time image processing. If the library finds Intel's Integrated Performance Primitives on the system, it will use these proprietary optimized routines to accelerate itself.

Officially launched in 1999, the OpenCV project was initially an Intel Research initiative to advance CPU-intensive applications, part of a series of projects including real-time ray tracing and 3D display walls. The main contributors to the project included a number of optimization experts in Intel Russia, as well as Intel’s Performance Library Team. In the early days of OpenCV, the goals of the project were described as

- Advance vision research by providing not only open but also optimized code for basic vision infrastructure. No more reinventing the wheel.
- Disseminate vision knowledge by providing a common infrastructure that developers could build on, so that code would be more readily readable and transferable.
- Advance vision-based commercial applications by making portable, performance-optimized code available for free—with a license that did not require to be open or free themselves.

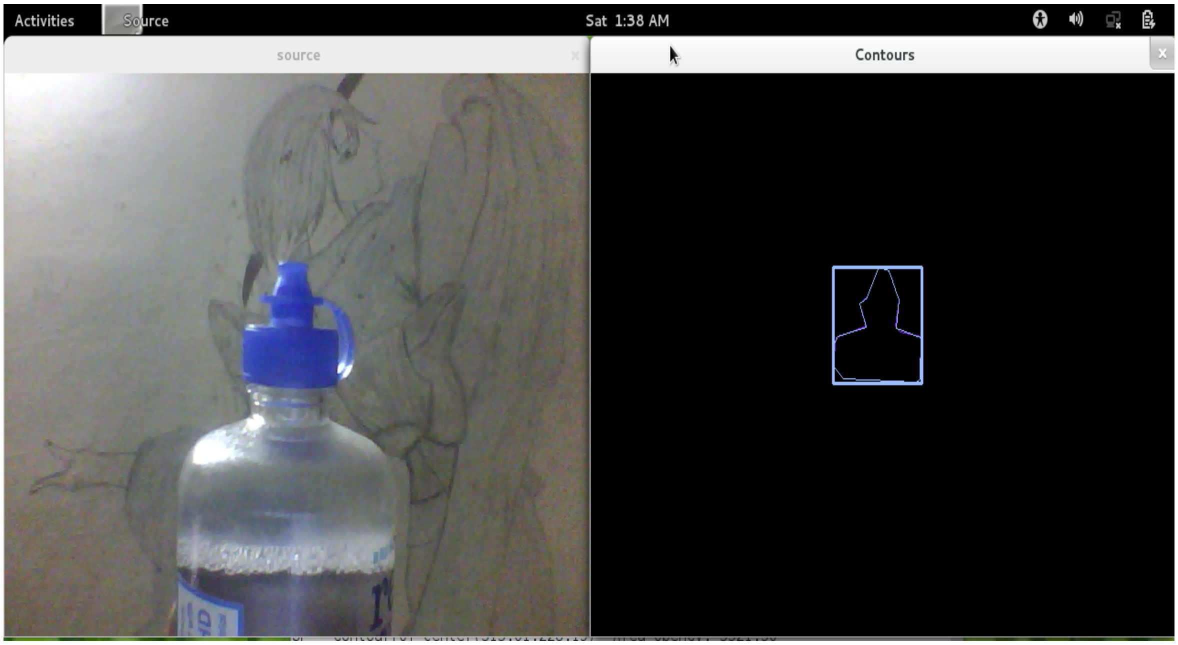


**Figure 6.5 OpenCV Detection**

OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. There are now full interfaces in Python, Java and MATLAB/OCTAVE. The API for these interfaces can be found in the online documentation. Wrappers in other languages such as C#, Ch, Ruby have been developed to encourage adoption by a wider audience. OpenCV runs on Windows, Android, Maemo, FreeBSD, OpenBSD, iOS, BlackBerry 10, Linux and OS X.

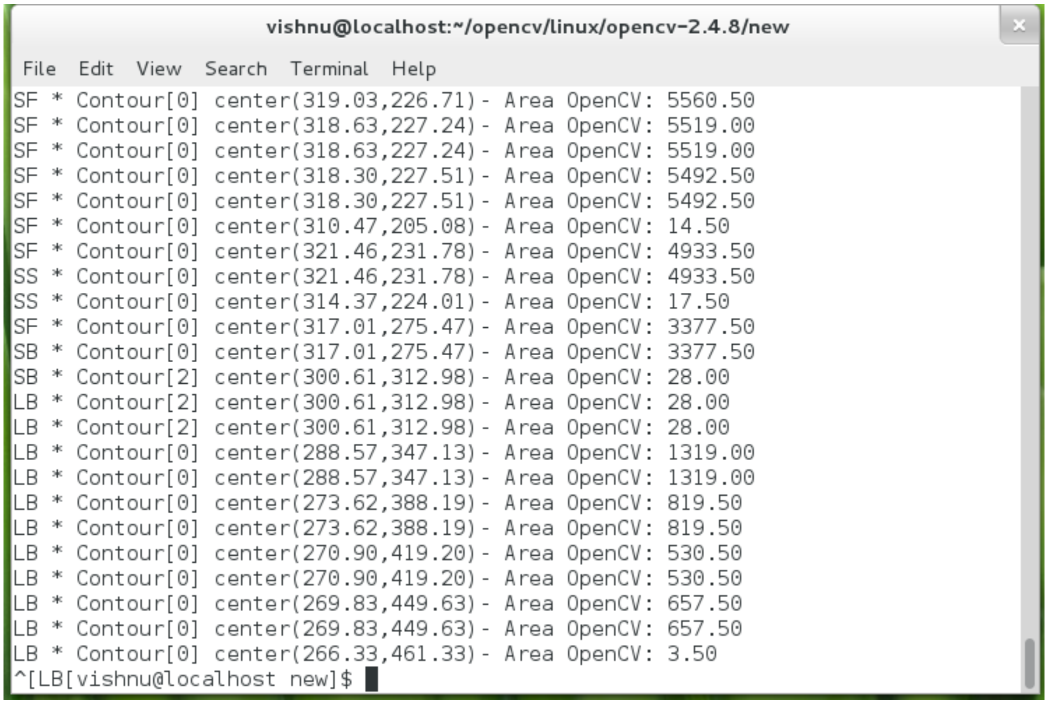


**Figure 6.6 Output of OpenCV**

## 6.5 IMAGE PROCESSING

The image processing of the system captures the image from the video stream of the camera and the selected image is filtered to obtain the required object. The system takes the input from the microprocessor that is determined by the image processing section. The filtered image is compared with the sample image, when the image matched the destination for the drilling area is identified and the task is being completed. This section also decides the path of the navigation and helps the vehicle to position for drilling area.

# CHAPTER 7

# RESULT AND CONCLUSION

This project, a social project to build an agricultural work to drill and sow seed.

We have successfully designed an autonomous robot for the agricultural purpose. The robot which has the capability, it can move by using the camera which is being placed at the front part of the robot after finding the spot the driller which is attached with the robot will make the hole in the ground and by using the funnel seed dropper the seed will be dropped in the hole which is made. This robot is decided to be used for the purpose of placing the coffee bean in the hill areas.

This robot is invented because the farm labors are started to move to the urban areas for the jobs were they can get higher wages. In order to over this situation this robot is invented. It is an autonomous robot so it can move by its own no need of labors. The mechanical designed well and good so that it can able to move in any terrain without any difficulty. The electrical and electronics components are selected well and good which makes the robot to move autonomous. Vision system seems to be a very important part of an efficient robot for two reasons. The one is that several elementary operation need guidance and control. In the greenhouse where the environment is not completely structured and changes can be caused by chance or by the action of human operators, a visual control for the localization of plants and obstacles seems an almost obliged choice. The second reason is that the artificial vision system integrated in a robot can itself perform evaluations, comparisons, and monitoring of growth and of other characteristics that cannot be performed by human operators and could become highly useful for optimal management of crops.

## 7.1 FUTURE SCOPE

Applications are many and various, but there is still great scope for further innovation. A constant grumble is the shortage of manpower for farming, both skilled and for seasonal harvesting operations. Intelligent robotics will be welcome in this most essential industry.

In agriculture generally, there are a number of issues that must be confronted.

- The ongoing loss of expertise in the industry.
- New robust, reliable sensors and actuators will be required to withstand the environmental extremes that are the basic working conditions in many agricultural areas.

A unit cost barrier exists due to the small profit margin of many agricultural areas. This will require either a generalized methodology for robotic system, or some other measure to lower unit costs.

# CHAPTER 8

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