IOT BASED INNOVATIVE AGRICULTURE AUTOMATION USING AGRIBOT

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ABSTRACT

Farmers today spend a lot of money on machines that help them decrease labor work and increase yield of crops.This paper deals with manufacturing and development of robot in agricultural applications. The main area of application of robots in agriculture is at the harvesting stage, digging, ploughing and seeding. This robot is designed to replace human labor. The jobs involved in agriculture are not straightforward and many repetitive tasks are not required to do, so the agricultural industry is behind other industries in using robots. This paper represents a robot capable of performing operations like automatic ploughing, seed dispensing. It also provides manual control when required. The main component is the microcontroller that supervises the entire process. Initially the robot digs the entire field simultaneously dispensing seeds side by side. On the field the robot operates on automated mode. For manual control the robot uses the Remote controller as control device and helps in the navigation of the robot on the field.

Keywords : WiFi module,Mobile application,IoT

1.INTRODUCTION

The main motive for developing Agricultural Automation Technology is the decreasing labour force, a phenomenon common in the developed world. The reasons are the need for improved food quality. Robotics and artificial intelligence achievements offer solutions in precision agriculture to processes related to seeding, harvesting, weed control, grove supervision, chemical applications, etc. to improve productivity and efficiency. In the current generation most of the countries do not have sufficient skilled man power in agricultural sector and it affects the growth of developing countries. So it's necessary to automate the sector to overcome this problem. In India there are 70% people dependent on agriculture. The application of agricultural machinery in precision agriculture has experienced an increase in investment and research due to the use of robotics applications in the machinery design and task executions. Precision autonomous farming is the operation, guidance, and control of autonomous machines to carry out agricultural tasks. It motivates agricultural robotics. It is expected that, in the near future, autonomous vehicles will be at the heart of all precision agriculture applications.

2.LITERATURE SURVEY

1. **Bak, T. and Jakobsen, H. 2003, Agricultural Robotic Platform with Four Wheel Steering for Weed Detection. Biosystems Engineering 87:2125-136. THESIS PDF**

Developed agriculture needs to find new ways to improve efficiency. One approach is to utilise available information technologies in the form of more intelligent machines to reduce and target energy inputs in more effective ways than in the past. Precision Farming has shown benefits of this approach but we can now move towards a new generation of equipment. The advent of autonomous system architectures gives us the opportunity to develop a complete new range of agricultural equipment based on small smart machines that can do the right thing, in the right place, at the right time in the right way.

2. **Blackmore, B. S., Fountas, S., Tang, L., and Have, H. 2004a, Design specifications for a small autonomous tractor with behavioural control, The CIGR Journal of AE Scientific Research and Development http://cigr-ejournal.tamu.edu/Volume6.html:Manuscript PM 04 001.**

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3. Blackmore, B. S., Fountas, S., Vougioukas, S., Tang, L., Sørensen, C. G., and Jørgensen, R. 2004b, Decomposition of agricultural tasks into robotic behaviours, The CIGR Journal of AE Scientific Research and Development In Press

A new method is described that can be used to decompose human controlled agricultural operations into an autonomous tractor. Four main levels of subsumption have been identified: Operation, Task, Optimization and Primitive Actions where each level is subsumed by the level above. Tasks were classified into two distinctive roles, deterministic tasks that can be planned and optimized before the operation begins and reactive tasks and their associated behaviours that deal with unknown conditions whilst in the field. The tasks and optimizations can be further decomposed into primitive actions, which in turn are converted into the tractor directory. Examples of this method are given for exploring an unknown area and ploughing a field.

4. Chamen,W.C.T., Dowler, D., Leede, P.R., and Long staff, D. J. 1994, Design, operation and performance of a gantry system: Experience in arable cropping, Journal of Agricultural Engineering Research 59:145-60.

This paper proposes Multifunctional robotic vehicle for agriculture application. Historically agriculture was carried out using hand held tools and as the civilization progressed people started using animal driven tools. After that autonomous ag robots for agriculture. In the developed countries the mechanized agriculture has reached to a matured state but in the developing countries like India is still evolving. The mechanized agriculture autonomous agri robots for improving agriculture productivity must increases to meet the future demand of the ever grooving humanpopulation to overcome it we will developing robotic vehicle. Agriculture robotic are machines programmed to do agricultural task and form assignments. Such as: Harvesting or picking, weeding, spraying, cutting. The challenge is designing and developing robots to work in harmony with the nature.

5. Godwin, R. J., Earl, R., Taylor, J. C., Wood, G. A., Bradley, R.I., Welsh, J. P., Richards, T., Blackmore, B. S., Carver, M. C., Knight, S. M., and Welti, B. 2001, Precision Farming of cereal crops: A five-year experiment to develop management guidelines, Project report 264e, -328pp, London, Home Grown Cereals Authority. http://www.hgca.com/ publications/ documents/crop research/267_Complete_Final_Report.pdf.

Variable-rate (VR) application of inputs in South African cash crop production is mainly concerned with fertilizer and lime, and this indicates the importance of these inputs.This paper studies the maize yield response tovariable-rate application of phosphorus (P) and the profitabilitythereof in South Africa, on the basis of datacollected on a 104-hectare experimental field on a farm in the Bothaville district. The strip-plot design of 180 strips was used for this on-farm research experiment. This designinvolved treatments that run in the same direction across the field as planting and harvesting. The objective is to determine the maize crop response functions under different P rates and toestimate the profitability of VR relative to the single-rate (SR) application of P. The methodology involvesmodelling maize yield response functions for P under VR and SR treatments, and for different management zones.

3.EXISTING SYSTEM

If farming is done manually then a lot of human efforts are required and then also the required quality work is not possible. Also there is wastage of seeds and fertilizers due to improper use of it. Also the harvesting part is very difficult manually because it may happen that the fruits are cut before their maturity level of it because grading of fruit is done manually. Manual harvesting method is slow and also very costly. It is not like the robots that work in factories building cars. Factories are built around the job at hand, whereas, farms are not. Robots on farms have to operate in harmony with nature. Robots in factories don't have to deal with uneven terrain or changing conditions.Many challenges in designing agribot.

4.PROPOSED SYSTEM

The combination of human and machine is able to incorporate the strengths of both sides and therefore increase the robustness of a system, decrease the development costs and efficiency has to be very high compared to other autonomous robots. On the whole our robot is to solve the farm fields' problems that includes manpower and involves high cost. The weed control and the fertilizer spraying were done by the man power in the older days. Now our robot will do that works without any human involvement.Aims to improve the functionality and reliability of an agricultural robot by using feedback provided by a human.The main goal of our work is to evaluate human- machine interaction scenarios in order to understand the effects of a human .A set of manual switches are used to control the robot action like for NPK measurement of soil, seeding, fertilizer spray, harvesting of on tree fruit. When the power supply is turned on the robot will be in idle mode it performs nothing till any one manual switch is pressed. As soon as the switch is pressed the robot will perform the dedicated taskprovided in the program. After the robot start performing the task at same time it can detect obstacles in the path of the robot using

IR sensors. If any obstacle comes in the path then the robot will try to avoid that obstacle by changing the path but at the same time it continuously monitors any other obstacles in the path. The robot will follow only the dedicated path if there is no obstacle in the path.

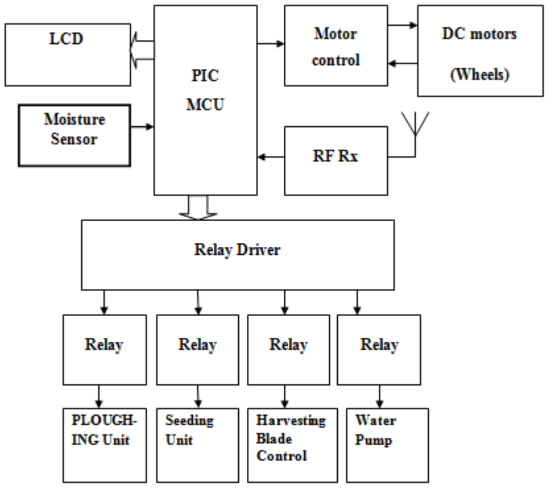
This System has a distributed wireless network of soil-moisture & temperature sensors placed in root zone of plants. Gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm was developed with threshold values of sensors that was programmed into a microcontroller-based gateway to control water quantity. Small embedded system device (ESD) which takes care of a whole irrigation process.

The assembly of the robotic system is built using high torque DC motor, communication module, relay driver circuit, Battery package, microcontroller which is shown in block diagram below. When DC motor is started, the vehicle moves along the particular columns of ploughed land for digging and sowing the seeds and its movement is controlled by remote guiding device.The robot starts its function by ploughing the field, then sows the seeds in the ploughed area and ends the process with covering the seeds sown with soil. It uses basic components like DC motors, stepper motor, relay and PIC as the main controller. The mechanical design of the robot is also simple. It is programmed to carry out the above functions simultaneously.

To perform the function of ploughing it is equipped with spiked rods which are fixed in the anterior end of the robot, to sow seeds it has a container with seeds and its bottom contains a perforation to drop the seed and finally the posterior end of the robot has a sloping metal sheet touching the ground to cover the sown seeds with soil as it moves forward. The mobile is placed in the front end of the agribot which helps to monitor the movement of the bot continuously. The Agribot is capable of doing multi-tasks and this can be said that it is a reconfigurable robot [1]. Reconfigurable means the tasks can be changed easily by a single command. Most of the robots can perform only single task or will be very difficult to command or change the task it performs. This mechanism is under research in the current scenario.

The robot is placed in the field and is switched on. This enables the movement of its wheels. To start ploughing another option must be selected. This starts the rotation of spiked wheels and thus starts ploughing which is done simultaneously as the robot moves forward. As the spiked wheels are in the front, a container is used for holding the seeds. A hole is drilled in the bottom of this container and that is covered with a small metal sheet. This sheet acts as a flip-flop and caters to the dropping of seeds at periodic intervals. The control of the various motors can be done in using the relay

BlockDiagram:



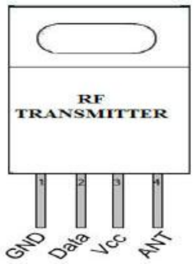
Soil moisture sensor

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners. Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential; these sensors are usually referred to as soil water potential sensors and include tensiometers and gypsum blocks.

RF TRANSMITTER AND RF RECEIVER

This **RF module** comprises of an **RF Transmitter** and an **RF Receiver**. The transmitter/receiver (Tx/Rx) pair operates at a frequency of **433MHz.** An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4.The transmission occurs at the rate of1Kbps -10Kbps. HT12E &HT12D are some commonly used encoder/decoder pair ICs.

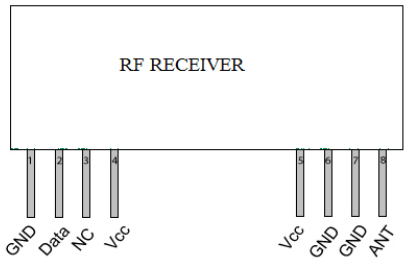
PIN DIAGRAM



PIN DESCRIPTION

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data input pin	Data
3	Supply voltage; 5V	Vcc
4	Antenna output pin	ANT

RF RECEIVER
PIN DIAGRAM



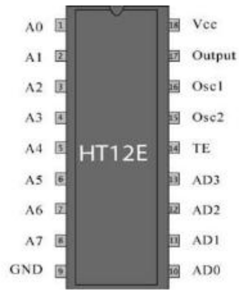
PIN DESCRIPTION

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data output pin	Data
3	Linear output pin; not connected	NC
4	Supply voltage; 5V	Vcc
5	Supply voltage; 5V	Vcc
6	Ground (0V)	Ground
7	Ground (0V)	Ground
8	Antenna input pin	ANT

ENCODER HT12E

HT12E is an **encoder integrated circuit** of 2^{12} series of encoders. They are paired with 2^{12} series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format.

PIN DIAGRAM



PIN DESCRIPTION

Pin No	Function	Name
1	8 bit Address pins for input	A0
2		A1
3		A2
4		A3
5		A4
6		A5
7		A6
8		A7
9	Ground (0V)	Ground
10	4 bit Data/Address pins for input	AD0
11		AD1
12		AD2
13		AD3
14	Transmission enable; active low	TE
15	Oscillator input	Osc2
16	Oscillator output	Osc1
17	Serial data output	Output
18	Supply voltage; 5V (2.4V-12V)	Vcc

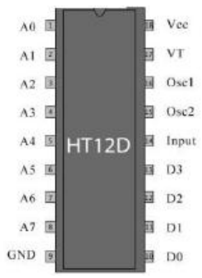
HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits.

HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

DECODER HT12D

HT12D is a **decoder integrated circuit** that belongs to 2^{12} series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with 2^{12} series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format.

PIN DIAGRAM



PIN DESCRIPTION

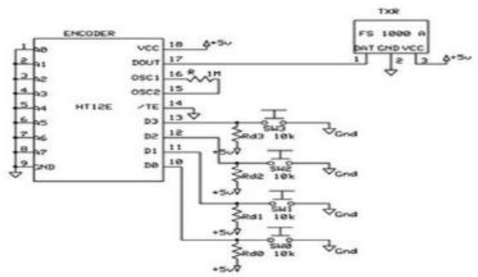
Pin No	Function	Name
1	8 bit Address pins for input	A0
2		A1
3		A2
4		A3
5		A4
6		A5
7		A6
8		A7
9	Ground (0V)	Ground
10	4 bit Data/Address pins for output	D0
11		D1
12		D2
13		D3
14	Serial data input	Input
15	Oscillator output	Osc2
16	Oscillator input	Osc1
17	Valid transmission; active high	VT
18	Supply voltage; 5V (2.4V-12V)	Vcc

In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received byan RF receiver, into parallel data and sends them to output data pins. The serial input data is comparedwith the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin.

HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

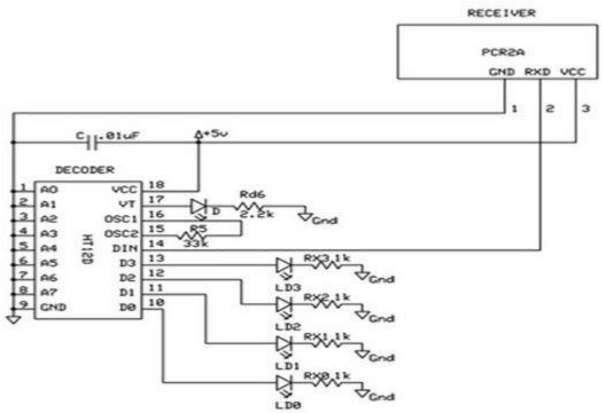
CIRCUIT DESCRIPTION

TRANSMITTER SECTION



The circuit has two parts transmitter and receiver. The transmitter part consists of RF transmitter module and HT12E. In the transmitter part we are using HT12E for encoding data from parallel to serial. The serial output from the encoder is fed to the data IN of the RF transmitter. The data output are connected to the PIC16F877A Microcontroller. The 5V supply is given to 18^{th} pin and GND is given to the 9^{th} pin of HT12E

RECEIVER SECTION



.The receiver part is consists of RF receiver module and HT12D. In the receiver part we are using HT12D for decoding data from serial to parallel. The parallel output from the decoder is fed to the RF receiver. The data output is connected to the port B in PIC16F877A Microcontroller. The 5V supply is given to 18^{th} pin and GND is given to the 9^{th} pin of HT12D.

PIC16F877A

INTRODUCTION

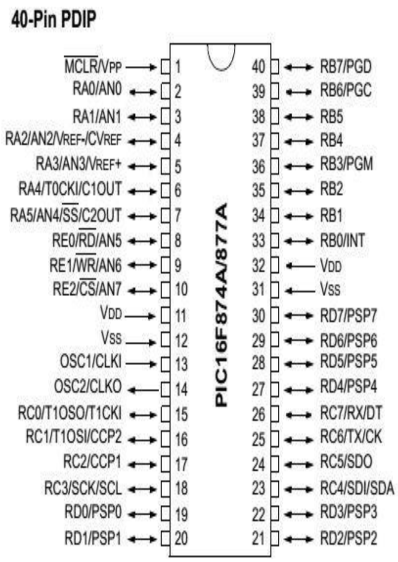
The PIC16F family of devices is CMOS (Complementary Metal OxideSemiconductor). CMOS technology offers a number of advantages over other technologies. For example, CMOS circuits consume very little power, operate over quite a wide voltage range and are quite forgiving of bad layout and electrical noise.The name PIC initially referred to**"Peripheral Interface Controller"**.

CORE ARCHITECTURE:

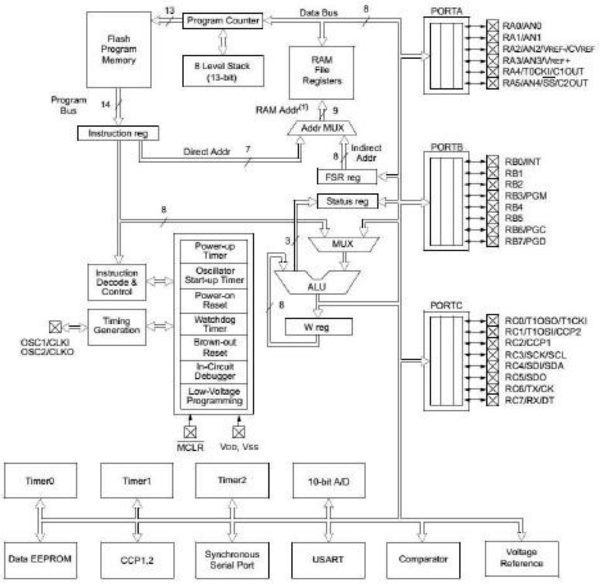
The PIC architecture is characterized by its multiple attributes:

- Separate code and data spaces (Harvard architecture) for devices other than PIC32, which has Von-Neumann architecture.
- A small number of fixed length instructions
- Most instructions are single cycle execution (2 clock cycles, or 4 clock cycles in 8-bit models), with one delay cycle on branches and skips
- One accumulator (W0), the use of which (as source operand) is implied (i.e. is not encoded in the OPCODE)
- All RAM locations function as registers as both source and/or destination of math and other functions.
- A hardware stack for storing return addresses
- A fairly small amount of addressable data space (typically 256 bytes), extended through banking
- Data space mapped CPU, port, and peripheral registers
- The program counter is also mapped into the data space and writable (this is used to implement indirect jumps).

PIN DIAGRAM



BLOCK DIAGRAM



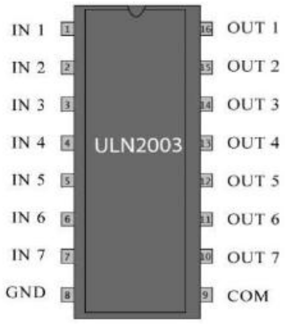
Device	Program Flash	Data Memory	Data EEPROM
PIC16F873A	4K words	192 Bytes	128 Bytes
PIC16F876A	8K words	368 Bytes	256 Bytes

RELAY DRIVER

ULN2003 is a high voltage and high current Darlington array IC. It contains seven open collector darlington pairs with common emitters. A darlington pair is an arrangement of two bipolar transistors.ULN2003 belongs to the family of ULN200X series of ICs. Different versions of this family interface to different logic families. ULN2003 is for 5V TTL, CMOS logic devices. These ICs are used when driving a wide range of loads and are used as relay drivers, display drivers, line drivers etc. ULN2003 is also commonly used while driving Stepper Motors.

Each channel or darlington pair in ULN2003 is rated at 500mA and can withstand peak current of 600mA. The inputs and outputs are provided opposite to each other in the pin layout. Each driver also contains a suppression diode to dissipate voltage spikes while driving inductive loads.

The ULN2004A/L and ULN2024A/L have series input resistors for operation directly from 6 to 15 V CMOS or PMOS logic outputs. The ULN2003A/L and ULN2004A/L are the standard Darlington arrays. The outputs are capable of sinking 500 mA and will withstand at least 50 V in the OFF state. Outputs may be paralleled for higher load current capability. The ULN2023A/L and ULN2024A/L will withstand 95 V in the OFF state.



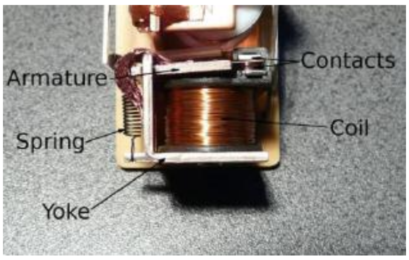
Pin diagram of the relay driver

These Darlington arrays are furnished in 16-pin dual in-line plastic packages (suffix “A”) and 16-lead surface-mountable SOICs (suffix “L”). All devices are pinned with outputs opposite inputs to facilitate ease of circuit board layout. All devices are rated for operation over the temperature range of -20–C to +85–C. Most (see matrix, next page) are also available for operation to -40–C; to order, change the prefix from “ULN” to “ULQ”.

RELAY

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it).

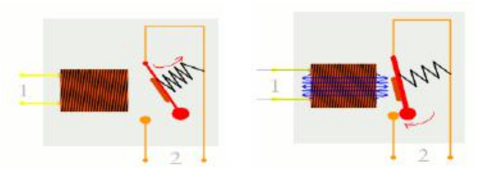
Basic design and operation



Simple Electromechanical Relay

How relays work

Here are two simple animations illustrating how relays use one circuit to switch on a second circuit.



(a) Relay off (b)Relay on

Relay on/off

When power flows through the first circuit (1), it activates the electromagnet (brown), generating a magnetic field (blue) that attracts a contact (red) and activates the second circuit (2). When the power is switched off, a springpulls the contact back up to its original position, switching the second circuit off again.The contacts in the second circuit are not connected by default, and switch on only when a current flows through the magnet. Other relays are "normally closed" (NC; the contacts are connected so a current flows through them by default) and switch off only when the magnet is activated, pulling or pushing the contacts apart. Normally open relays are the most common

DC MOTOR

A DC motor is any of a class of rotary electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

Camera

A camera is an optical instrument for recording or capturing images, which may be stored locally, transmitted to another location, or both. The images may be individual still photographs or sequences of images constituting videos or movies. The camera is a remote sensing device as it senses subjects without physical contact. The word camera comes from camera obscura, which means "dark chamber" and is the Latin name of the original device for projecting an image of external reality onto a flat surface. The modern photographic camera evolved from the camera obscura. The functioning of the camera is very similar to the functioning of the human eye.

DC GEARED MOTOR

A motor is a machine which converts energy into rotating motion. The dictionary definition of motor is broader than that but when engineers and mechanics talk about motors they are almost always talking about rotating motion. There are different names for devices which convert energy into other types of motion. The hub or drive shaft is the rotating output of the motor.

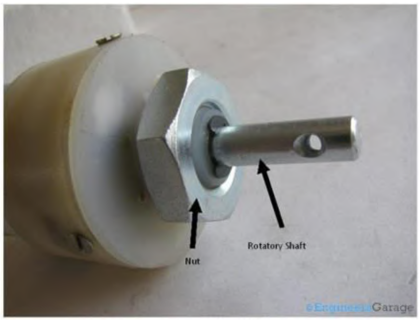
A DC motor is a motor that uses direct electrical current (DC) as the source of its energy. An AC motor is a motor that uses alternating electrical current (AC) as the source of its energy. AC current is the type of electricity provided by household wall outlets. DC current is the type of electricity provided by batteries.

A gear motor is a motor with an attached set of gears driving a secondary drive shaft. Practical motor designs result in motors that spin too fast for most uses. As a result, almost all gear sets are used to "gear down" the motor. The geared down drive shaft spins slower than the direct motor drive shaft. The geared down drive shaft also spins "harder". Motor speed is generally measured in revolutions per minute (RPM). Rotating force is called torque and for hobby motors is generally measured in inch-ounces or centimeter-grams. We will discuss torque more in a future chapter of this tutorial. For now, just remember that the higher the number the harder the motor turns. Gearing down a motor reduces its RPMs (speed) but increases its torque. Conversely, gearing up a motor increases its RPMs but decreases its torque.

Gears are generally contained within a housing that protects the gears from interference and which provides a bearing surface for the various gear shafts and drive shafts. The term gear box generally refers to the entire system of gears, shafts, bearings andhousing.

When you apply energy to a motor it spins as fast and hard as its design allows for that energy level and output load. If you increase the energy supply it spins faster and harder. If you attach a load the motor will slow down. If you continue increasing the load it slows ever more until the motors capability to work is exceeded. When the extreme load causes the motor to stop it is said to be stalled. Reducing the load causes the motor spin faster. If you entirely remove the load the motor is said to be "free running" and operates at its maximumspeed.Geared DC motors can be defined as an extension of DC motor which already had its Insight details demystified here. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

The lateral view of the motor shows the outer protrudes of the gear head. A nut is placed near the shaft which helps in mounting the motor to the other parts of the assembly.



Also, an internally threaded hole is there on the shaft to allow attachments or extensions such as wheel to be attached to the motor. From the start, DC motors seem quite simple. Apply a voltage to both terminals, and it spins. But what if you want to control which direction the motor spins? Correct, you reverse the wires. Now what if you want the motor to spin at half that speed? You would use less voltage. But how would you get a robot to do those things autonomously? How would you know what voltage a motor should get? Why not 50V instead of 12V? What about motor overheating? Operating motors can be much more complicated than you think.

VOLTAGE

Typical DC motors are rated from about 6V-12V. The larger ones are often 24V or more. But for the purposes of a robot, you probably will stay in the 6V-12V range. So why do motors operate at different voltages? As we all know (or should), voltage is directly related to motor torque. More voltage, higher the torque. But don't go running your motor at 100V causethats just not nice. A DC motor is rated at the voltage it is most efficient at running. If you apply too few volts, it just wont work. If you apply too much, it will overheat and the coils will melt. So the general rule is, try to apply as close to the rated voltage of the motor as you can. Also, although a 24V motor might be stronger, do you really want your robot to carry a 24V battery (which is heavier and bigger) around? My recommendation is do not surpass 12V motors unless you really really need the torque.

CURRENT

As with all circuitry, you must pay attention to current. Too little, and it just won't work. Too much, and you have meltdown. When buying a motor, there are two current ratings you should pay attention to. The first is operating current. This is the average amount of current the motor is expected to draw under a typical torque. Multiply this number by the rated voltage and you will get the average power draw required to run the motor. The other current rating which you need to pay attention to is the stall current. This is when you power up the motor, but you put enough torque on it to force it to stop rotating. This is the maximum amount of current the motor will ever draw, and hence the maximum amount of power too. So you must design all control circuitry capable of handling this stall current. Also, if you plan to constantly run your motor, or run it higher than the rated voltage, it is wise to heat sinkyour motor to keep the coils from melting.

How high of a voltage can you over apply to a motor? Well, all motors are (or at least should be) rated at a certain wattage. Wattage is energy. Efficiency of energy conversion directly relates to heat output. Too much heat, the motor coils melt. So the manufacturers of [higher quality] motors know how much wattage will cause motor failure, and post this on the motor spec sheets. Do experimental tests to see how much current your motor will draw at a desired voltage. The equation is:

Power (watts) = Voltage * Current There is a special case for DC motors that change directions. To reverse the direction of the motor, you must also reverse the voltage. However the motor has a built up inductance and momentum which resists this voltage change. So for the short period of time it takes for the motor to reverse direction, there is a large power spike. The voltage will spike double the operating voltage. The current will go to around stall current. The moral of this is design your robot power regulation circuitry properly to handle any voltage spikes.

TORQUE

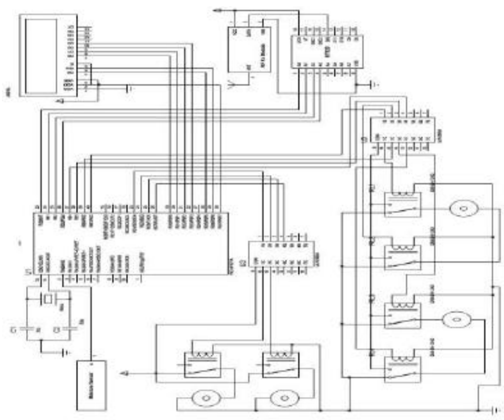
When buying a DC motor, there are two torque value ratings which you must pay attention to. The first is operating torque. This is the torque the motor was designed to give. Usually it is the listed torque value. The other rated value is stall torque. This is the torque required to stop the motor from rotating. You normally would want to design using only the operating torque value, but there are occasions when you want to know how far you can push your motor. If you are designing a wheeled robot, good torque means good acceleration. My personal rule is if you have 2 motors on your robot, make sure the stall torque on each is enough to lift the weight of your entire robot times your wheel radius. Always favor torque over velocity. Remember, as stated above, your torque ratings can change depending on the voltage applied. So if you need a little more torque to crush that cute kitten, going 20% above the rated motor voltage value is fairly safe (for you, not the kitten). Just remember that this is less

VELOCITY

Velocity is very complex when it comes to DC motors. The general rule is, motors run the most efficient when run at the highest possible speeds. Obviously however this is not possible. There are times we want our robot to run slowly. So first you want gearing - this way the motor can run fast, yet you can still get good torque out of it. Unfortunately gearing automatically reduces efficiency no higher than about 90%. So include a 90% speed and torque reduction for every gear meshing when you calculate gearing. For example, if you have 3 spur gears, therefore meshing together twice, you will get a 90% x 90% = 81% efficiency. The voltage and applied torque resistance obviously also affects speed.

CIRCUIT DIAGRAM EXPLANATION

When AC is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of DC needed. In our circuit the transformer of 230v/15v is used to perform the step down operation where a 230V AC appears as 15V AC across the secondary winding. In the power supply unit, rectification is normally achieved using a solid-state diode. Diode has the property that will let the electron flow easily in one direction at proper biasing condition. As AC is applied to the diode, electrons only flow when the anode and cathode is negative. Reversing the polarity of voltage will not permit electron flow. A commonly used circuit for supplying large amounts of DC power is the bridge rectifier. A bridge rectifier of four diodes (4*IN4007) is used to achieve full wave rectification. Two diodes will conduct during the negative cycle and the other two will conduct during the positive half cycle. The DC voltage appearing across the output terminals of the bridge rectifier will be somewhat less than 90% of the applied RMS value. Filter circuits, which usually capacitor is acting as a surge arrester always follow the rectifier unit. This capacitor is also called as a decoupling capacitor or a bypassing capacitor, is used not only to 'short' the ripple with frequency of 120Hz to ground but also to leave the frequency of the DC to appear at the output. The voltage regulators play an important role in any power supply unit. The primary purpose of a regulator is to aid the rectifier and filter circuit in providing a constant DC voltage to the device. Power supplies without regulators have an inherent problem of changing DC voltage values due to variations in the load or due to fluctuations in the AC liner voltage. With a regulator connected to the DC output, the voltage can be maintained within a close tolerant region of the desired output. The regulators IC7812 and 7805 are used to provide the +12v and +5v to the circuit.



Agricultural robot

PIC16F877A is a 40 Pin DIP pack IC with 33 I/O pins. Out of which 9 pins can be used either as Digital I/O pins or Analog Input pins. The micro controller is having 5 ports Port A, Port B, Port C, Port D and Port E. Here Port A consists of 6Pins and can be used as Analog Pins and Digital Pins, in the same way Port E consists of 3Pins all of them can either be used as Analog Pins or Digital Pins. The Port pins of Port D are connected to LCD pins. RD0 to RD3 pins are data pins and RD5 to RD7 pins are control pins. The wind sensor and light sensor are connected to the port A of the microcontroller. The charge controller unit is connected to the port C of the microcontroller. The Pins 13 and 14 are connected to Oscillators. This Oscillator provides required clock reference for the PIC microcontroller. Either Pins 11 and 12 or 31 and 32 can be used as power supply pins. The 5v supply is given to the 11^{th} and 32 pin and GND is connected to the 12^{th} and 31^{th} pin of microcontroller. Pins 25 and 26 of Port C are used for serial Port communications; these pins are interfaced with MAX232 for PC based communications. Pins 39 and 40 are used for In-Circuit Debugger Operations, with which the hex code is downloaded to the Chip. Pin 33 is used as external Interrupt Pin. Pin 1 is used as Reset Pin. This Pin is connected to Vcc through a resistor.

The LCD we have used in this project is HD1234. This is an alphanumeric type of LCD with 16 pins. Of which Pins 7 to 14 are used as data pins, 11 to 14 pins are connected to port D of PIC16F877A microcontroller. There are 3 control pins RS (Pin-4), RW (Pin-5) and EN (Pin-6). The RS pin is connected to the 29^{th} Pin of micro controller. The RW pin is usually grounded. The RW is connected to 28^{th} Pin. The EN pin is connected 30^{th} pin. The LCD has two Rows and 16 Columns. The LCD is powered up with 5V supply connected to Pins 1(GND) and 2(Vcc). The Pin 3 is connected to Vcc through a Potentiometer. The potentiometer is used to adjust the contrast level. Here in our project we use the PIC controller in 4-bit mode. Here only 4 data pins are connected and are used as Data Port.

The RS pin is connected to the 27^{th} Pin of micro controller. The RW pin is usually grounded. The RW is connected to 26^{th} Pin. The EN pin is connected 28^{th} pin. The LCD has two Rows and 16 Columns.

RF transmitter unit consist of transmitter module and HT12E encoder. The HT12E has 18 pins. The 9^{th} pin of HT12E is GND and the 18^{th} pin of HT12E is Vcc. Pin 10-13 of HT12E is connected to the 37-40pin of port B in PIC16F877A microcontroller. HT12E has Transmission Enable (TE) pin, which is LOW we cause the transmitter section to transmit the data on pins 10-13. RF receiver unit consist of receiver module and HT12D decoder. The HT12D has 18 pins. The 9^{th} pin of HT12D is GND and the 18^{th} pin of HT12D is Vcc. Pin 10-13 of HT12D is connected to the 37-40 pin of port B in PIC16F877A microcontroller. HT12D has Valid Transmission (VT) pin, which is HIGH we cause the receiver section to receive the data on pins 10-13. RF transmitter, receiver pair has frequency which has 434.

A temperature sensor LM35 is interfaced to the ADC port of PIC16F877A microcontroller. The output voltage from the LM35 is linearly proportional to the measuring temperature. The internal ADC converts the output voltages from the LM35 into digital signals, which correspond to the measured temperature. The Three pins are VCC, Output and Ground. The output voltage of the LM35 increases by 10 mV per 1° rise in temperature. This LM35 can measure temperature ranging from -55°C to 150°C.The 5V supply is given to the 1^{st} pin and GND is given to the 3^{rd} pin of LM35. The 2^{nd} pin (output) of LM35 is connected to the 2^{nd} pin of PIC16F877A microcontroller.

The relays are connected to microcontroller through ULN2003 relay driver IC. The ULN2003 has 16 pins. The 9^{th} pin of ULN2003 is Vcc and 8^{th} pin of the ULN2003 is GND. The 12V supply is given to the 9^{th} pin of the ULN2003. The ULN2003 has 7 input pins (1-7) and 7 output pins (10-16). The ULN consists of Darlington arrays. The 1^{st} pin of ULN2003 is connected to the 33^{rd} pin of the PIC16F877A microcontroller. The 16^{th} pin of the ULN2003 is connected to the relay, which drives the relay and the relay which drives the DC motor.

6.SOFTWARE DESCRITION

MPLAB IDE

MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip's PIC® and dsPIC® microcontrollers. MPLAB IDE runs as a 32-bit application on MS Windows®, is easy to use and includes a host of free software components for fast application development and super-charged debugging

PIC KIT 2

ThePICkit™2 Development Programmer/Debugger is a low-cost development tool with an easy to use interface for programming and debugging Microchip's Flash families of microcontrollers. The full featured Windows® programming interface supports baseline (PIC10F, PIC12F5xx, PIC16F5xx), midrange (PIC12F6xx, PIC16F), PIC18F, PIC24, dsPIC30, dsPIC33, and PIC32 families of 8-bit, 16-bit, and 32-bit microcontrollers, and many Microchip Serial EEPROM products.PICkit™ 2 enables in-circuit debugging on most PIC® microcontrollers. In-Circuit-Debugging runs, halts and single steps the program while the PIC microcontroller is embedded in the application.PICkit 2 uses an internal PIC18F2550 with FullSpeed USB. The latest PICkit 2 firmware allows the user to program and debug most of the 8 and 16 bit PIC micro and dsPIC members of the Microchip product line.The PICkit 2 is open to the public, including its hardware schematic, firmware source code (in C language) and application programs (in C# language). End users and third parties can easily modify both the hardware and software for enhanced features. e.g. GNU/Linux version of PIC Kit 2 application software, DOS style CMD support, etc. The PICkit 2 has a programmer-to-go (PTG) feature, which can download the hex file and programming instructions into on-board memory (128K byte I2C EEPROM or 256K byte I2C EEPROM), so that no PC is required at the end application.The Microchip version of PICkit 2 has a standard 128K byte memory. 256K byte memory can be achieved by modifying the hardware or from third party..

CONCLUSION

This robotics agricultural machine is designed to facilitate the farmers to ease their work and increase the productivity with its multitasking working features such as automatic seeding system, automatic pest control unit, automatic compost spraying etc.By developing this robotic vehicle with its multi-tasking agricultural features, it overcomes the difficulty of farmers in farming their land in every season no matter what is the weather that day. Considering all the situations, the robot integrated with different sub modules can be used for redemption and agricultural purposes worldwide especially countries like India where agriculture provides the principal means of livelihood for the major Indian population.

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