Research Paper

MOBILE OPERATED LAWNMOWER

K Prasada Rao[1]* V RamBabu[1], K Santa Rao[1] and D Venkata Rao[1]

Corresponding Author: **K Prasada Rao** ✉ kancherlakp@gmail.com

Lawnmowers are the grass cutters which are used to cut the grass in the fields. Now a days growing grass became interior decoration for the companies, colleges, and various other places. But to maintain this grass in a proper way we need grass cutters. In the early 1827's lawnmowers are used as conventional grass cutters. Later, in order to improve its efficiency and automate the process of grass cutting various new technologies such as remote operated lawnmowers arrived. In remote operated lawnmowers the range of grass cutting equipment is limited as the signal strength is very weak and also the equipment required for these lawnmowers is sophisticated and expensive. In this work to overcome these limitations remote controlled lawn mower is incorporated with a mobile phone which acts as a link between user and grass cutter.In this work, two mobile phones are used in which one acts as a transmitter and the other as a receiver. Mobile phone that makes a call to the mobile phone attached to the circuit of lawnmower. In the course of a call, if any button is pressed, a tone corresponding to the button pressed is heard at the other end of the call. This tone is called 'dual-tone multiple-frequency' (DTMF) tone. The microcontroller perceives this DTMF tone with the help of the phone stacked in the lawn mower. The received tone is processed by the microcontroller with the help of DTMF decoder MT8870. The decoder decodes the DTMF tone into its equivalent binary digit and this binary number is sent to the microcontroller. The microcontroller is preprogrammed to take a decision for any given input and output. It's decision to motor driver in order to drive the motor for forward or backward motion or a turn. The cutter is turned on or off with the help of a mobile phone by a number which is instructed in the program. The mobile that makes a call to the mobile phone stacked in the lawn mower acts as a remote and performs the function of a grass cutter.

Keywords: Lawn Mower, Mobile phones, Rechargeable, Cutting Efficiency, Surgical Blade

INTRODUCTION

The aesthetic value of this environment is as important as food and shelter to the modern man. In general, grasses are found to survive in a variety of conditions and thus the need to curtail their growth in order to enhance the beauty of our habitat environment. As man evolved intellectually, grass cutting inevitably

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[1] Department of Mechanical Engineering , GMRIT-Rajam, INDIA-532127.

developed to an art. As technology advanced grass cutting developed, away from use of machetes, hoes and cutlasses to motorized grass cutters. Technology had continued to advance and better techniques of grass cutting has been invented and constantly improved upon. This gave birth to the invention of lawn mower. A lawn mower is a machine used for cutting grass or lawns. A lawn is any area of grass; mostly tough grass which is neatly cut like in a private garden or a public park.

The first lawn mower was invented in 1830 by Edwin Beard Budding.(Passmore, Everett G *et al.*, 1879). He said that he obtain the idea after watching a machine in a local cloth mill which used a cutting cylinder mounted on a bench to trim clothes for a smooth finish after weaving. Budding realized that a similar concept could be used to cut grass if the mechanism is mounted in a wheel frame to enable the blades rotate close to the lawns surfac.

Thomas Green patented the first lawn mower to be driven by chains, a fundamental development named Silent Messer which implies silent running. In 1861 Ransomes re-entered the lawn mower market with their now improved machine. Although Ransomes in 1867 introduced a totally new design of mower, the Automaton which became an instant success with over 1,000 machines being sold in the first season. This design was to put Ransomes level with the other two main producers, Shanks and Green. Follows and Bates entered the market in 1869 with a mower called the Climax. This machine was a major innovation - the land roller was removed and replaced by two land wheels

placed on the outside of the side-frames. A gear inside the land wheel drove the cutting cylinder andthe machine had fewer parts and was much lighter and cheap in costs.It was shown at the International Exhibition of 1862 along with Shanks, Ferrabee and Green. (Hall and Duck Trust *et al.*, 2011).

By late 1890, motorized mowers appeared as light weight petrol engines and small steam power units became available. Gasoline powered lawn mowers were first, manufactured in 1914 by Ideal Power. Ideal Power Mower also introduced the world's first self-propelled, riding lawn tractor in 1922, known as the "Triplex. In US, Colonel Edwin George produced the first gasoline powered mower in 1919. Electric powered mowers and rotary cutting machines emerged in the 1920's and 1930's.

The objective of this paper, is to control the motion of robot by a mobile phone (as transmitter) that makes call to the mobile-phone (as receiver) attached to the robot. Control of rover is done by any mobile device that does not restrictits motion. Mowing the lawn with a standard motor powered lawn mower is an inconvenience, and no one takes pleasure in it and cannot be easily accomplished by elderly, younger, or disabled people because they can some- times cause danger. The blades of self-powered push mowers (gas oline or electric) can injure a careless or in attentive operator; as such, many come equipped with a dead man's switch to immediately disable the blade rotation when it is not being operated. In the United States, over 12,000 people per year are hospitalized as a result of lawn mower accidents (Costilla V and Bishai D M, 2006)

Motor powered push lawn mowers and riding lawn mowers create noise pollution due to the loud engine, and local air pollution due to the combustion in the engine. Also, a motor powered engine requires periodic main-tenance such as changing the engine oil. Even though electric lawn mowers are envi-ronmentally friendly, they too can be an inconvenience. Along with motor powered lawn mowers they also hazardous and cannot be easily used by all. Also, if the electric lawn mower is corded, mowing could prove to be problematic and dangerous. The transition from traditional hand-guided or ride-on mowers to automaticelectric mowers is beginning to take place, with the growth in robotic lawn mower sales of 2012 (Kinnander and Ola, 2012). The self-propelling electric and mobile operated lawn mower is robotic user friendly, cost efficient, safe to use, efficient to use, environmentally friendlyand can reduce noise pollution and no need of fuel and engine (Cheryl Springfels *et al.*, 2011).

Along with the various ages of users, this lawn mower can also be used by people who have disabilities and are unable to use a regular push, or riding lawn mower. The prototype will also be automatic and will run on a charged battery with no cords to interfere with operation this cordless electric lawn mower includes control capability through mobile phones which is less expensive than a robotic lawn mower with sensor capability (Hollis and Scott, 2005). With its control capability the lawn mower stays within the boundaries of the lawn because the user is able to have control over the lawn mower with the controller.

The main objective to extend the design of currently used lawn mower, and to improve the capabilities of standard robotic lawn mowers by increasing its range as well as assuring cost efficiency. Most consumers will be able to use this device as it is safe to use, as well as efficient because it electric powered and cordless.

All the above systems are controlled by the Micro controller. In our project we are using the popular 8 bit micro controller AT 89C51. It is a 40 pin micro controller. The Micro controller AT89C51 is used to control the dc motors. It gets the signals from the DTMF decoder and it drives the moto rs according to the DTMF in puts. Two D C motors a reused to drive the rover in four directions i.e. Front, Back, Right, Left. With the instructions given to micro controller through program it is moved along the lawn and performs the grass cutting operation by using a two surgical blades which acts as a cutter which are separated by 180 degrees.

BLOCK DIAGRAM DESCRIPTION

The block diagram of the micro controller based mobile operated lawn mower. In this the total equipment is run through the 2 mobile phones which are equipped with the headset in which one mobile act as trans-mitter and the other as a receiver. The impor-tant components used to run the cutter along with moment of chassis is micro controller with DTMF decoder and motor driver. An MT 8870 Series DTMF decoder is used here. DTMF signaling is used for telephone signaling over the line in the voice frequency band to the call switching center. The version of DTMF used for telephone dialing them

obilet hat makes a call to th e mobile phones tacked in the robot acts as a remote is known as touch tone. DTMF assigns a specific frequency (consisting of two separate tones) to each keys that it can easily be identified by the electronic circuit. Here the decoder converts the input signal into output signals inform of the hex file which is programmed by using the KILE software. And the input program used is instructed according to the information that is given to mobile phones that is the directions are controlled through buttons on the mobile phone. And the output is received through another mobile which acts as a receiver. According to the output received by mobile phones the motor driver drives the cutter and the wheels and performs the operation of cutting or the moment of the chassis in desired directions. (P Raghavendra Prasad and K Susram Rahul, 2008).

In this work we programmed to have left, right, front, backward directions for the numerical key 4,6,2,8 respectively. And so on and off the motor we have used 5 and to switch on or off the cutter 0 is used. Thus the controlled movement of the chassis is performed.

HARDWARE COMPONENTS

- Chassis
- Wheels
- Grass Cutter
- DC Motors
- Power Supply
- Arduino-uno
- 2 Mobile Phones

Chassis

The material of the Chassis is of plywood because and it is rectangular shaped. And it is provided with spaces for mounting components. Ithas more strength and has more resistant to vibrations which are created due to the moments of chassis and it has more stiffness than that of Steel. And it is excellent corrosion resistance. The main physical properties are low density, durable, ductile, malleable. It has the temperature resistance upto 100-1600c and does not affect to plywood size. The front wheels to drive, and back wheels to make a turn. And the whole moment of the chassis is dependent on the circuit of Arduino - Uno.

S.No.	TERMS	ISI REQUIREMENTS	RESULTS
	Table 1: Mechanical Properties of Wood		
1	Moisture content	15%	7.20%
2	Glue shear strength in dry condition	Individual Min-1078.7 N Average Min.- 1329.9 N	1450 N 1700 N
3	Glue shear strength in wet condition	Individual Min- 784.5 N Average Min.- 580.7 N	1250 N 1420 N
4	Glue shear strength in	Individual Min- 784.5N Average Min.- 580.7N	1120 N 1300 N
5	Tensile strength 1.Parallel to gain direction 2.Right angle to gain direction 3.Sum of two directions	Min - 470 Kg/cm^2 Min - 250 Kg/cm^2 Min - 845 Kg/cm^2	645 Kg/cm^2 395 Kg/cm^2 1040 Kg/cm^2

Figure 1: Block Diagram of Mobile Operated Lawnmower
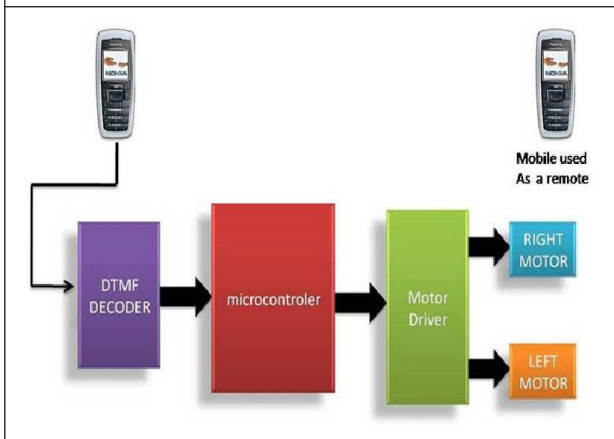
Figure 2: Chassis

Figure 3: Straight Type Tyres

Wheels

When constructing any robot, one major mechanical constraint is the number there a two-wheel drive or a four-wheel drive. Though four-wheel drive is more complex than two-wheel drive, it provides more torque and good control. Two-wheel drive, on the other hand, is very easy to construct.

Wheels are classified based on their Design of land. The Various types are straight helical. And they are also classified Based on their applications Such as Tuberous wheels which are used on hilly areas and highly stone areas.

In this work used helical types of wheels so that they can easily move on high hill areas and heavy bush places without any obstruct.

Grass Cutter

A Lawn mower is a machine that uses one or more revolving blades to cut a lawn to an even height. The blades may be powered either by hand by pushing the mower forward, or may have an internal combustion engine to spin their blades. Some mowers also include other abilities, like mulching or collecting their clippings.

Two main styles of blades are used in lawn mowers. Lawn mowers employing a single blade that rotates about a single vertical axis are known as rotarymowers, while those employing a multiple blade assembly that rotates about a single horizontal axis are known as cylinders or reel mowers.

There are several types of mowers, each suited to a particular scale and purpose. The smallest types are pushed by a human user and are suitable for small residential lawns

and gardens. Riding mowers are larger than push mowers and are suitable for large lawns. The largest multi-gang mowers are mounted to tractors and are designed for large expanses of grass such as golf courses and municipal parks.

Figure 4: Surgical Blades

In this work 2 surgical blades are used which is carbon steel and low weight. Sandvik provides hardened and tempered cold-rolled strip steel used for surgical scalpel blades. Here we use single blade cutter and corrosive resistances and it has excellent edge properties, and enables grinding, high sharpness, tough and stable edge. Even with low speed the grass can be cut very easily. And thus it increases the efficiency of grass cutting.

Grade and their Description

Sandvik Bio line 13C26: Martensitic stainless chromium steel which after hardening is characterized by very high hardness and wear resistance and good corrosion resistance.

Sandvik 13RM19: An austenitic stainless steel combining high mechanical strength with a non-magnetic structure. The grade has good fatigue properties and excellent ductility.

Sandvik Bio line 4C27A: The hardened stainless chromium steel characterized by very good machinability. It has highhardness and high wear resistance after hardening.

Table 2: Components and their Percentges in Carbon Steel	
Components	**Weight%**
C	Max 0.15
Fe	97.91 - 98.7
MN	0.85 - 1.15
P	0.04 - 0.09
Pb	0.15 - 0.35
S	0.26 - 0.35

Table 3: Mechanical Properties of Carbon Steel	
Hardness, Rockwell B	84
Density	0.284 lb/in³
TensileUltimateStrength	540 MPa
Tensile Yield Strength	415 MPa
Elongation at Break	10%
Modulus of Elasticity	200 GPa
Bulk Modulus	140 GPa
Poisson's Ratio	0.29
Shear Modulus	80 GPa

Motor

A unit which creates mechanical energy from electrical energy and which transmits mechanical energy through the gear box at a reduced speed is a Gear motor. A gear head and motor combination is to reduce the speed of the motor to obtain the desired speed or torque.

Figure 5: Motor

Gear motors of all types and sizes include single/ multiphase, universal, servo, induction and synchronous types. DC gear motors are configure dinmanyty pes and sizes, including brushless and servo. A DC gear motor consists of a rotor and a permanent magnetic field stator and an integral gearbox or gearhead. The magnetic field is maintained using either permanent magnets or electro magnetic windings. DC motors are most commonly used invariable speed and torque applications. ADC servo motor has an out puts haft that can be positioned by sending a coded signal to the motor.

As the input to the motor changes, the angular position of the output shaft changes as well. Servo motors are generally small and powerful for their size, and easy to control. Common types of DC servo motors include brushless or gear motor types. Stepper motors are classes of motors that provide incremental motion, or steps, in response to pulses of current that alternately change the polarity of the stator poles; step motors do not require feed back and are sometimes used in "Open Loop,"

Important performance specifications to consider when searching for gear motors include shaft speed, continuous torque, and continuous current and continuous output power. The terminal voltage is the design DC motor voltage. The continuous torque is the output torque capability of the motor under constant running conditions.

Continuous current is the maximum rated current that can be supplied to the motor windings without over heating. Continuous output power is the mechanical power provided by the motor output.

Important DC motor specifications to consider include terminal voltage, motor construction and commutation. The terminal voltage is the design DC motor voltage. Motor construction choices include permanent magnet, shunt wound, series wound, com pound wound, discarmature, and coreless or slotless. Important gearing specifications to consider for gear motors and gear heads include the gearing arrangement, gearbox ratio, and gearbox efficiency. Gearing arrangement choices for gear motors or gearheads includes pur, planetary, harmonic, worm, and bevel. Gearbox ratio is the ratio of input speed to output speed. A ratio greater than one, therefore, indicates speed reduction, while a ratio less than one indicates speed increase. Efficiency is the percentage of power or torque that is transferred through the gearbox. Losses occur duet of actors such as friction and slippage inside the gearbox.

In this work two types of motors are used

- Cutter motor: 12000 rpm motor with torque less and should resist the cutter weight

- Drive motor: 200 rpm with 5 kg torque and it should resist the weight of the chassis and can able to resist the vibrations during operation

Power Suuply

Here using rechargeable batteries as means of power supply. There are 2 batteries, in which one battery is of a 12v 1.3AH battery to run motor which used drive the chassis that is 4 wheels and cutter. And we are using.

When acsign alisgivent ot he primary of the transformer due to the magnetic effect of the coil magnetic flux is induced in the coil (primary) and transfer to the secondary coil of the transformer due to the transformer action. Transformer is an electro mechanical static device which transforms electrical energy from one coil to another without changing its frequency.

Figure 6: Battery
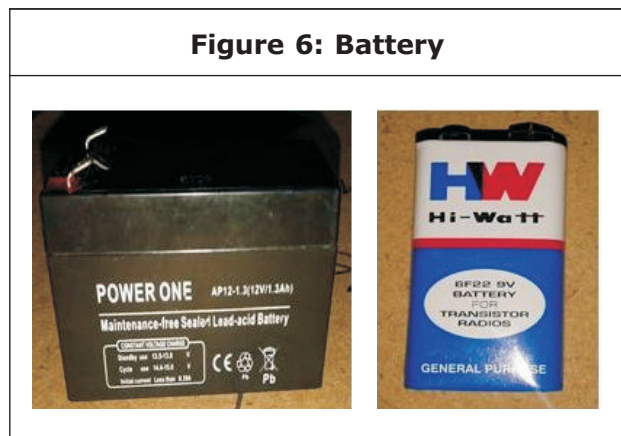
Arduino Uno

Arduino is a single-board micro controller intended to make the application of interactive objects or environments more accessible.The hardware consists of an open-source hard-ware board designed aroundan 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. Current models feature an USB interface, 6 analogue input pins, as well as 14 digital I/O pins which allow to attach various extension boards.

It is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains every-thing needed to support the microcontroller.

It is simply connected to a computer with a USB cable or powered with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega 8U2 progra-mmed as a USB-to-serial converter.

Figure 7: Arduino-Uno
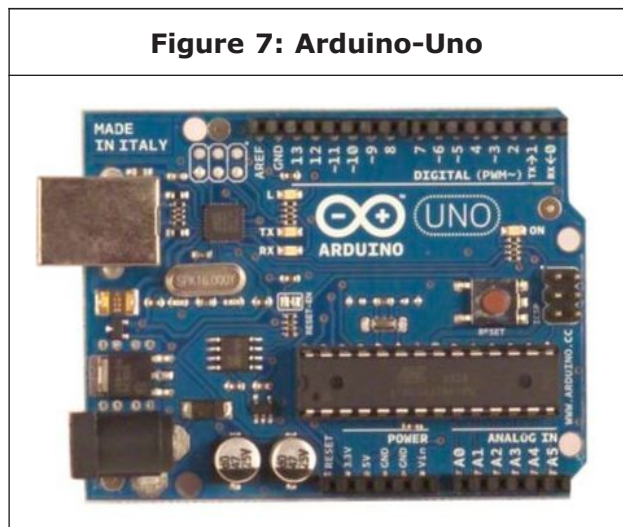
Technical Specifications

MODEL CALCULATIONS
Chasis

Weight of the chassis = 2kg

Speed of the drive motors = 300 rpm

Diameter of the wheel = 6.8 cm

Table 4: Technical Specifications	
Domain	Chassis equipped with grass cutter, Wireless communication
Micro Controller	AT89C52
Communication Device	DTMF Decoder
Transmitter	Mobile phone
Receiver	Mobile phone
Battery	9V
Rechargable Battery	12v 1.3AH
Cutter Motor	12000 rpm, Torque less
Driver Motor	200 rpm, 5 kg Torque

We have,

Power required to drive the chassis (P) = F*V

And we know F $= M*G$

$= 2*9.81$

$=19.62$

Where, F= Force

V = Velocity = $(\pi*d*n)/60$

M= Mass

G= Acceleration due to gravity

Velocity 'V' = $(\pi*0.068*300)/60$

$=1.068$ m/sec

Power 'P' = F*V

$= 19.62*1.068$

$= 20.96$ W

Hence power required to drive the Chassis = 20.95W

Wheel Motor

Speed of the drive motor = 300 rpm

We have,

Torque (T) = F*R

Where,

F = Force =M*G

R=Perpendicular distance =0.034

Therefore,

Torque 'T' = F*R

$=1*9.81*0.034$

$=0.33$ N-m

Power Obtained from the Wheel Motor

= $(2*\pi*N*T)/60$

$=(2*\pi*30*0.33)/60$

= 10.46 W

Hence Power Obtained from the

1 wheel motor = 10.46 W

Therefore power obtained from the

2 wheel motors = 2.092 W

Cutter Specifications

Speed of the Cutter Motor= 12000 rpm

Diameterof the Cutter Shaft= 9cm=0.09m

Torque (T) = F*r

Where,

r = Perpendicular distance to cutter axis = 0.045

Therefore, Torque 'T' = 0.275*0.045

$=0.0124$ N-M

Power required to run the cutter Motor= $(2*\pi*N*T)/60$

= $(2*\pi*12000*0.0124)/60$

= 15.6 W

Hence, Power required to run the cutter Motor = 15.6 W

Battery Specifications

Voltage of the battery 'v' = 12V

Current obtained from battery 'i' = 1.3 A

Power obtained from the battery = v*i

$= 12*1.3$

= 15.6 W

Hence, Power obtained from the battery = 15.6W

DESIGN PRINCIPLE

The objective of this paper, is to control the robot by a mobilephone (as transmitter) that makes call to the mobilephone (asreceiver) attached to the robot. Now after answering the call, and in the course of the call, if any button is pressed control corres ponding tothebutton pressed is heard at the other end of the call. This tone is called dual tone multi frequency tone (DTMF) robot receives this DTMF tone with the help of phones tacked in the robot.

The received tone is processed by the 89S52 micro controller with the help of DTMF decoder MT8870 the decoder decodes the DTMF tone into its equivalent binary digit and this binary number is send to the micro controller, the micro controller is pre programmed to take a decision for any give input and outputs its decision to motor drivers in order to drive the motors for forward or backward motion or a turn.

So this simple robotic project does not require the construction of receiver and transmitter units. DTMF signaling is used for telephone signaling over the line in the voice frequency band to the call switching center. The version of DTMF used for telephone dialing the mobile that makes a call to the mobile phones tacked in the robot acts as a remote is known as touch tone. DTMF assigns a specific frequency (consisting of two Separate tones) to each keys that it can easily be identified by the electronic circuit.

Figure 8: Module Design
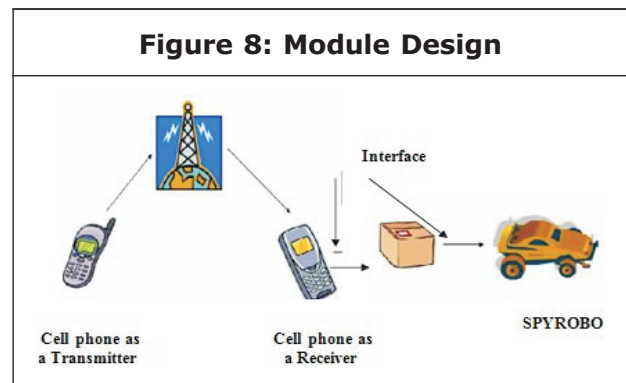
Module Block Diagram

The signal generated by the DTMF decoder is the direct algebraic submission, in realtime of the amplitudes of two sine (cosine) waves of different frequencies, i.e., pressing 5 will send a tone made by adding 1336Hz and 770 Hz to the other end of the mobile.

The detected application by the DTMF encoder in ther over section is interface to the personal computer through the DTMF decoder and micro controller. so the DTMF encoding and decoding is used for the transmission and receiving of data respectively.

Figure 9: Rover Controlling Section
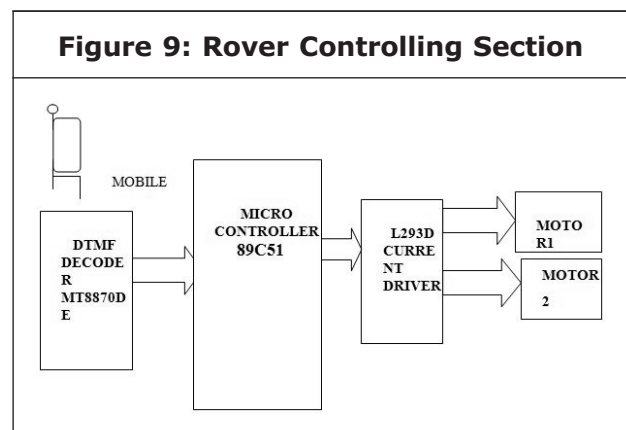
Operation

The operation of transmitter is done using a DTMF decoder, an Arduino Uno and L293D Motor Driver. The transmitter section is rover

which was controlled by the mobile and it is arranged with certain applications attached through the encoder and Arduino Circuit. The controlled and the desired path are followed by using controller and transmitted using transmitter and is furthered operated accordingly if any unwanted material is detected in its surroundings while it moves.

The designed lawn mower can move in four directions forward, backward, left and right. The directions are controlled by the DTMF decoder and the pre programmed Arduino and the grass is cut along with the moment of the rover along the desired path in the lawn. The technique we used here is DTMF technique for the controlling of the rover, i.e. we know that each key in the mobile key pad issum of two frequencies that is column and row frequencies so each key had different frequency. By using DTMF decoder we can convert the frequency in to that particular binary number. Initially the rover consist a mobile connected with headset. The mobile headset is connected to the DTMF decoder input. Here the mobile act as a receiver to give a moment for ther over in a required direction. Initially that is kept in auto answer mode. By making the call to mobile which was attached to the rover from any other mobile (transmitter) the call was attempted automatically because of the auto answering facility. Now if we press any key in the mobile (transmitter) the DTMF decoder decodes that frequency into its binary form. The out put depends upon the input applied to it that is the output of the DTMF decoder. The Arduino gives the output based on a pre programmed logic given to it. The code is written in such a way that it enables the

motors to move the rover in required direction and performs the grass cutting operation. (P Raghavendra Prasad and K Susram Rahul, 2008).

The output current from the arduino circuit is about 10 mA which is not sufficient to drive the motors. So here L293D, a current driver is used. The current driver serves the purpose by increasing the current to about 600m A which is sufficient enough to drive the motors. An encoder is also attached to the rover, which is used to transmit the data related to the applications provided at there over. All the outputs of applications are connected to the encoder which transmits this data to the receiver section there by providing us the required information regarding the environmental round the rover and the grass cutter.

Figure 10: Circuit
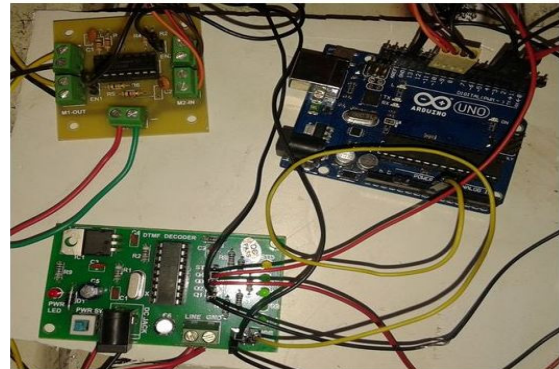
Applicationsof the Circuits

The rover we designed is an application that can detect the presence of the motion, temperature, water and smoke when the rover proposed to move in the desired direction. All the above application circuits described below.

- Motion Detector
- Smoke Detector
- Temperature Detector
- Water Detector

CONCLUSION

The advantage sex plained earlier in this chapter justify the significance of a mobile based robotic arm. The application are as a real so vast with the simplest of modifications. Since all we need is a mobile call establishment to instruct the robot due to the cell phone's un ending and cheap availability, this is highly feasible. Thesignals received at the robot's mobile are decoded with DTMF decoder which is easy touse. No heavy motors are employed in the making of the robot, and thus it becomes very light weight. The level of sophistication is quite low and hence its working is user friendly.

This method is having good expected results. Thus the proposal should be considered for the most important system for the safety the costliest human life and the nation property. Since this robot is highly flexible adding components to facilitate application specific working yields a robot that has high use in vast areas. This project can also be subjected to standardization and hence has a good future scope.

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