Design and Study of Fire Fighting Robot

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Abstract: **From the recent years, robotics has turned out to be an ingredient over which many people had shown their interest. Robotics has gained popularity due to the advancement of many technologies of computing and nano technologies. So, I have decided to design something that can make humans life easier and comfortable. Here my interest of review is to make an automated fire fighting robot which can help in dealing with many fire problems in households and small scale industries. Now I am not concentrating on making a fire fighting robot that can deal with fire on large scale because I want to proceed by step by step. The need of the hour is to make a device which can detect fire, even if it is small and take the necessary action to put it off. Many household items catch fire when someone is either sleeping or away and that lead to many hazardous conditions if the fire is not putted off in time. So, my work as an mechanical engineer is to design and build a system that can detect and extinguish fire. I have used very basic concept here, easy to understand from the prospective of beginners or for the masters of this field.**

Keywords: Robotics, Nano Technology, Extinguish, self-autonomous.

1. INTRODUCTION

My research is describes the design of a small autonomous Fire Fighting Robot. I have worked on the same project at my college presenting a synopsis showing its basic construction and working. The Fire Fighting Robot is designed to search for a fire in a small floor plan of a house of the specific dimensions, extinguish the fire with the help of a toy hovercraft, and then return to the front of the house. This mission is divided into smaller tasks, and each task is implemented in the most efficient manner such as self-autonomous start of the robot, navigation of the robot in every room step by step, finds the fire in a specific room, approaches the fire at a very fixed distance, and extinguishes it and finally returning to the front of the house. Finding the target or fire is achieved by the remote control. The very important and crucial concept of this Fire Fighting Robot is that it navigates and extinguishes the candle by colliding with the wall of the floor plan to at least extent. Along with these crucial tasks were other design constraints, such as the size, speed, and supply of power. The size of the robot should be small enough so that it could perform its task quickly and efficiently. The speed should be fast enough to perform the task on time. The supply of power should be enough to do the extinguishing process and economically feasible as well making the whole vehicle light and comfortable. Each defining characteristic of the robot is described in more detail here.One of the major hazards associated with fire fighting operations is the toxic environment created by combusting materials. The four major hazards associated with these situations are smoke, the oxygen deficient atmosphere, elevated temperatures, and toxic atmospheres. Additional risks of fire include falls and structural collapse.

2. ELEMENTS OF PROJECT

A. Galvanised Iron or Steel

Corrugated Galvanized iron or steel, corrugated sheet metal, occasionally abbreviated CGI) is a building material composed of sheets of hot-dip galvanized mild steel, cold-rolled to produce a linear corrugated pattern in them. The corrugations increase the bending strength of the sheet in the direction perpendicular to the corrugations, but not parallel to them. Normally each sheet is manufactured longer in its strong direction. GI is lightweight and easily transported. It was and still is widely used especially in rural and military buildings such as sheds and water tanks. Its unique properties were used in the development countries like Australia from the 1840s, and it is still helping developing countries today. Corrugated iron is equivalent to tin roof.Common sizes of corrugated material can range from a very thin 30 gauge (0.012 inches, 0.30 mm) to a relatively thick 6 gauge (0.1943 inches, 4.94 mm). Thicker or thinner gauges may also be produced.The corrugations are described in terms of pitch (the distance between two crests) and depth (the height from the top of a crest to the bottom of a trough). It is important for the pitch and depth to be quite uniform, in order for the sheets to be easily stackable for transport, and to overlap neatly when joining two sheets. Pitches have ranged from 25 mm (1 inch) to 125 mm (5 inches). It was once common for CGI used for vertical walls to have a shorter pitch and depth than roofing CGI. This shorter

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 04, April-2017

pitched material was sometimes called "rippled" instead of "corrugated". However nowadays, nearly all CGI produced has the same pitch of 3 inches (76 mm).

B. DC DIAPHRAGM WATER PUMP

Features
Smooth operation
Self-priming
Silent running
Low power draw
Runs dry without damage
Easy connecting system
Duty Cycle: Intermittent

Specification
Flow: 1.07 GPM (4 L/min)
Volts: 12V
Amp Draw: 2.6amp
Pressure: 80 PSI
Product Size: 17 cm (L) x 10cm (W) x 6.2cm (H)
Weight: 0.82 kg
Motor duty cycle will vary with load and ambient temperature.

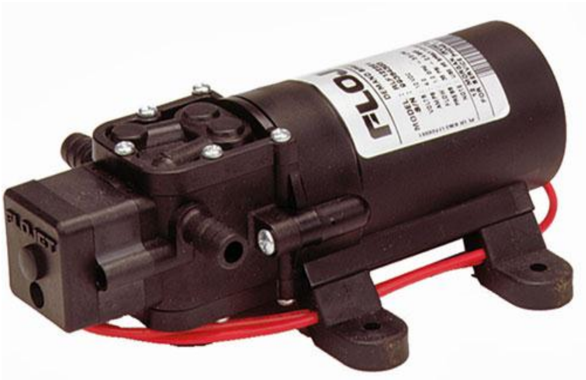

Fig1. Picture of water pump

A diaphragm pump (also known as a Membrane pump, Air Operated Double Diaphragm Pump (AODD) or Pneumatic Diaphragm Pump) is a positive displacement pump that uses a combination of the action of a rubber, thermoplastic or Teflon diaphragm. Those in which the diaphragm is sealed with one side in the fluid to be pumped, and the other in air or hydraulic fluid. The diaphragm is flexed, causing the volume of the pump chamber to increase and decrease. A pair of non-return check valves prevents reverse flow of the fluid. Those employing volumetric positive displacement where the prime mover of the diaphragm is electro-mechanical, working through a crank or geared motor drive, or purely mechanical, such as with a lever or handle. This method flexes the diaphragm through simple mechanical action, and one side of the diaphragm is open to air. Those employing one or more unsealed diaphragms with the fluid to be pumped on both sides. The diaphragm(s) again are flexed, causing the volume to change.
When the volume of a chamber of either type of pump is increased (the diaphragm moving up), the pressure decreases, and fluid is drawn into the chamber. When the chamber pressure later increases from decreased volume (the diaphragm moving down), the fluid previously drawn in is forced out.[3] Finally, the diaphragm moving up once again draws fluid into the chamber, completing the cycle. This action is similar to that of the cylinder in an internal combustion engine.

Nozzles: The nozzle is a critical part of any sprayer. Nozzles perform three functions:

1. Regulate flow

2. Atomize the mixture into droplets

3. Disperse the spray in a desirable pattern.

Nozzles are generally best suited for certain purposes and less desirable for others. In general, herbicides are most effective when applied as droplets of approximately 250 microns; fungicides are most effective at 100 to 150 microns, and insecticides at about 100 microns compare various nozzles, their droplet sizes and their effectiveness for broadcast spraying compares nozzle characteristics for banding or directed spraying. Nozzles determine the rate of fluiddistribution at a particular pressure, forward speed, and nozzle spacing. Drift can be minim-sized by selecting nozzles that produce the largest droplet size while providing adequate coverage at the intended application rate and pressure. Working of a nozzle depends upon mainly four things which are flow rate because it has large effect on water drop size In-creasing nozzle size to the next step up in size is an excellent way to reduce the number of driftable fines. Spray pressure influences the formation of droplets from the spray solution. The spray solution emerges from the nozzle in a thin sheet, and droplets form at the edge of the sheet.

C. DC MOTOR

This is a device that converts DC electrical energy to a mechanical energy.This DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field; it experiences a torque and has a tendency to move. This is known as motoring action. If the direction of electric current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force.The direction of rotation of a this motor is given by Fleming’s left hand rule, which states that if the index finger, middle finger and thumb of your left hand are extended mutually perpendicular to each other and if the index finger represents the direction of magnetic field, middle finger indicates the direction of electric current, then the thumb represents the direction in which force is experienced by the shaft of the dc motor.

Fig2. D C Motor

Structurally and construction wise a direct current motor is exactly similar to a DC generator, but electrically it is just the opposite. Here we unlike a generator we supply electrical energy to the input port and derive mechanical energy from the output port. We can represent it by the block diagram shown below.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 04, April-2017

D. DPDT (Double Pole Double Throw) Switch

It is dual ON-ON - A pair of on-on switches which operate together. These can be very useful formotor control because you have forward, off and reverse positions. Momentary (ON-ON) versions are also available where the switch returns to the central off position when released. A double pole double throw toggel switch act exactly like two SPDT switches separate common terminal and each of those is connected to one or yhe other of the two terminals on the same side of switch.

Fig3. DPDT Switches

E. ADOPTOR

AC/DC adapter or AC/DC converter is a type of external power supply, often enclosed in a case similar to an AC plug. Other names include plug pack, plug-in adapter, adapter block, domestic mains adapter, line power adapter, wall wart, and power adapter. Adapters for battery-powered equipment may be described as chargers or rechargers (also battery charger). AC adapters are used with electrical devices that require power but do not contain internal components to derive the required voltage and power from mains power. The internal circuitry of an external power supply is very similar to the design that would be used for a built-in or internal supply.

External power supplies are used both with equipment with no other source of power and with battery-powered equipment, where the supply, when plugged in, can sometimes charge the battery in addition to powering the equipment.

Use of an external power supply allows portability of equipment powered either by mains or battery without the added bulk of internal power components, and makes it use.

Originally, most AC/DC adapters were linear power supplies, containing a transformer to convert the mains electricity voltage to a lower voltage, a rectifier to convert it to pulsating DC, and a filter to smooth the pulsating waveform to DC, with residual ripplevariations small enough to leave the powered device unaffected. Size and weight of the device was largely determined by the transformer, which in turn was determined by the power output and mains frequency. Ratings over a few watts made the devices too large and heavy to be physically supported by a wall outlet. The output voltage of these adapters varied with load; for equipment requiring a more stable voltage, linearvoltage regulator circuitry was added. Losses in the transformer and the linear regulator were considerable; efficiency was relatively low, and significant power dissipated as heat even when not driving a load.AC adapters are widely used to power small or portable electronic devices.

The advantages include:

Safety — External power adapters can free product designers from worrying about some safety issues. Much of this style of equipment uses only voltages low enough not to be a safety hazard internally, although the power supply must out of necessity use dangerous mains voltage. If an external power supply is used, the equipment need not be designed with concern for hazardous voltages inside the enclosure. This is particularly relevant for equipment with lightweight cases which may break and expose internal electrical parts.

Heat reduction — Heat reduces reliability and longevity of electronic components, and can cause sensitive circuits to become inaccurate or malfunction. A separate power supply removes a source of heat from the apparatus.

Electrical noise reduction — Because radiated electrical noise falls off with the square of the distance, it is to the manufacturer's advantage to convert potentially noisy AC line power or automotive power to "clean", filtered DC in an external adapter, at a safe distance from noise-sensitive circuitry. Weight and size reduction — Removing power components and the mains connection plug from equipment powered by rechargeable.

Ease of replacement — Power supplies are more prone to failure than other circuitry due to their exposure to power spikes and their internal generation of waste heat. External power supplies can be replaced quickly by a user without the need to have the powered device repaired.

3. CONCLUSION

Through this we can conclude that a robot can be used in place of humans reducing the risk of life of the fire fighters. We can use them in our homes, labs, offices etc. They provide us greater efficiency to detect the flame and it can be extinguish before it become uncontrollable and threat to life. Hence, this robot can play a crucial role. Fire fighting robot can be easily and conveniently used. Operate automatically when any fire occurs. Robot comprises of very small size, less in weight, hence require less space. Rechargeable batteries are used here. Rechargeable batteries produce less waste because they can be recharged with a simple battery charger and reused hundreds of times. Each task is implemented in the most efficient manner such as self-autonomous start of the robot, navigation of the robot in every room step by step, finds the fire in a specific room, approaches the fire at a very fixed distance, and extinguishes it and finally returning to the front of the house. Finding the target or fire is achieved by the remote control. The very important and crucial concept of this Fire Fighting Robot is that it navigates and extinguishes the candle by colliding with the wall of the floor plan to at least extent. Along with these crucial tasks were other designs constraints, such as the size, speed, and supply of power and it can through 10-15 feet water.

4. FUTURE SCOPE

Here in my paper I have shown you a small construction and basic operating conditions. Through this review paper of mine, I want to design a robot which can deal with fire with dry ice but due to its high cost of operating and environment unsmoothing, I have dropped the idea of using it. But what I want here is to find an alternative to the fan operated by servo motor. I want to fabricate a device that uses a case that can be sprayed on the fire to put it off and I am working to find an alternate of dry ice. Also, a camera can be fitted on the robot head so one can operate it manually without having the robot visible to that person. The potage of the camera can be send to the displaying LCD's through the mean of wireless communication. Hence this project of mine can serve in dealing with fire problems.

5. PERSPECTIVE

Overall our system performed fairly well. We encountered many small challenges to its functionality, but were able to overcome these problems using a variety of hardware and software approaches. (Compared to the challenges faced by the Stanford Cart, we consider ourselves modifying the turning amounts

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 04, April-2017

caused by various bump sensors eliminated much of the problem of getting stuck in loops, while adding a bumper helped the robot avoid getting its front bump sensors stuck while turning. Various additions to the extinguishing functionality increased the chance that the robot would successfully put out the candle when it was found. Though our robot can usually put out the candle given enough time, a few areas could still be significantly improved. Mainly, the searching method of the robot could be much more robust. Adding sensors like sonar, a compass, or GPS would allow the robot to map its environment, and find the candle much more efficiently. Secondly, once the candle is found, a stronger fan would help ensure that the robot is able to put it out. Working on this project has suggested that further investigation into locating and mapping environments would be beneficial. In addition, its performance would be improved by improving some of the hardware specifically, making the motors of equal power and improving the fan's performance.

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