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Saarthi: A Versatile Robot

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Abstract:
Saarthi is a pick and place robot which is remote controlled using WiFi. It has a camera which gives live feed. Saarthi is operated through laptop. The live feed which is obtained via camera can be viewed on laptop. Saarthi is basically used for surveillance. It monitors all the tasks. In addition to this, the robotic arm is given for picking up objects, switching on/off switches basically for handling. The main power source is solar but in case if it has to be used in shade a backup battery source is provided. Saarthi is small and a compact robot hence it can reach the places which will be difficult for humans. The central interface used in Saarthi is freedom board. All the components are interfaced together using WiFi. Saarthi can be divided into two parts software and hardware. Hardware part involves the motor driver circuitry, switching circuitry, battery level indicator and software includes the WiFi interfacing, coding of dc and servo motor. There have been other projects made using Arduino and Zigbee but the freedom board supports interfacing of more number of components. Saarthi is a soft automation based robot which boosts the efficiency of tasks performed.

Keywords: *Soft automation, solar power, WiFi control*

1. Introduction

In the world where security is given a high importance there is a constant need of updated technology. . Not only for security but in all the fields old machines are replaced by the better working machine. With increase in all tasks becoming machine oriented robots are used for surveillance, supervision and many other mechanical tasks as well. There have been many efforts in making robots for surveillance. Most commonly robots are made using Zigbee and Arduino. Many robots have RF technology that is interfaced with the central system. This adds in the number of components required and the robot ends up being bulky. Saarthi is a robot which overcomes all the shortcomings of other robots. Saarthi is a multitasking robot. It works on WiFi and the central unit is freedom board. WiFi provides long range and the freedom board is used since it works on high speed and can interface many components. It is compact. All the operational commands are given via laptop. It is very simple for the user to move the robot and also control the arm via laptop. The robotic arm can be used for doing various tasks eg: picking anything, switching o/off, carrying around objects etc. The arm is based on articulated type of robot which has RRR axis. This robot has a complex work envelope. Camera is present on the robitic arm of the robot. The live feed of this camera on computer, hence it becomes very simple for the user to monitor tasks. The main power source is solar energy. A solar panel is placed on the upper surface of robot so that it can get proper exposure to sunlight. A battery is given for backup to carry out the tasks without hassle. . To make the task simpler and manageable, software is created on the computer for the sake of user.

2. Design and Implementation

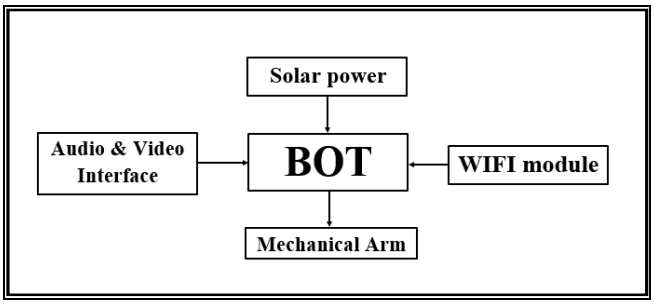

Figure 1: Block diagram of the project

The above block diagram represents how all the different components are linked together. The central interface acts as the master which gives command to all other components linked to it. The central interface is the freedom board. Freedom board is a device which has operating frequency of 48MHz, 128KB of flash, a full-speed USB controller, and loads of analog and digital peripherals. The FRDM-KL25Z hardware is form-factor compatible with the Arduino™ R3 pin layout, providing a broad range of expansion board options. Since in Saarthi many elements have to be interfaced freedom board provides a perfect platform. The output voltage obtained through freedom board is around 3 volts to 5 volts.

It is powered by solar power source which is attached on top of the robot. Battery is provided as backup in case when robot needs to be operated in absence of sunlight. A relay switching circuit is used for switching the power source from solar to battery. When the power becomes less than 11volts relay switches the source from one to another.

A relay has five terminals in which two terminals are connected via coil, two terminals are fixed contacts and the remaining terminal is moving. Voltage is applied to the coil in relay. Relay works on the principal of magnetic flux. When voltage exceeds 7.5V, flux is induced and the contact is shifted through the pivot. This is how the solar battery gets connected across the supply.

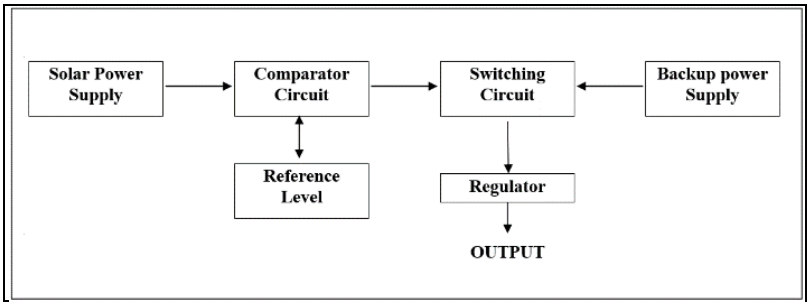

Figure 2: Block diagram of supply switching circuit

Along with this circuit we need to use motor driver circuit since the current required for driving single motor at a time is 0.11A and when all four motors used simultaneously the total current requirement increases four times that is 0.44 A. The output voltage obtained from freedom board is 3.3 volts and the current range is in microamperes. Since the requirement is very high and available current and voltage is low the need of motor driver circuit arises. It is basically used for this purpose.

The battery level is indicated by another circuit with the help of few LEDs. The glowing LEDs indicate different values of voltage. Reference voltage can be set by using pot.

Camera transmits the live feed through RF camera; it has a separate audio video transmitter receiver for the same.

In Saarthi WiFi module (HLK-RM04) is used. The module is configured using the address 192.168.16.254. Using this, the IP address of WiFi network is added. The module is used in WiFi (serial)-client mode. The serial inputs from the WiFi board are connected to serial inputs of the FRDM-KL25Z board. The control signals are sent trough the WiFi board to the FRDM-KL25Z. These signals are of the form w, s, a, d which are used to move the robot and its arm.

Saarthi is robot based on electric drive. They provide less speed and power than hydraulic system although the nuisance caused by leak oil does not occur. The accuracy and repeatability provided by this is much better. They require less floor space as well. These are actuated by dc servomotors and dc stepping motors. They are ideally suited to actuation of rotational joints through appropriate drive trains and gear systems. They can also be used to actuate linear joints by means of pulley and other translational mechanisms.

Saarthi is basically based on articulated robot. These robots are also called as revolute or anthropomorphic robot. The work envelope in this robot is more for same physical link lengths.

Point to point path motion is used in Saarthi. The end effecter in this follows a prescribed path in 3 dimensional spaces, and the speed of motion along the path may vary.

Software design:

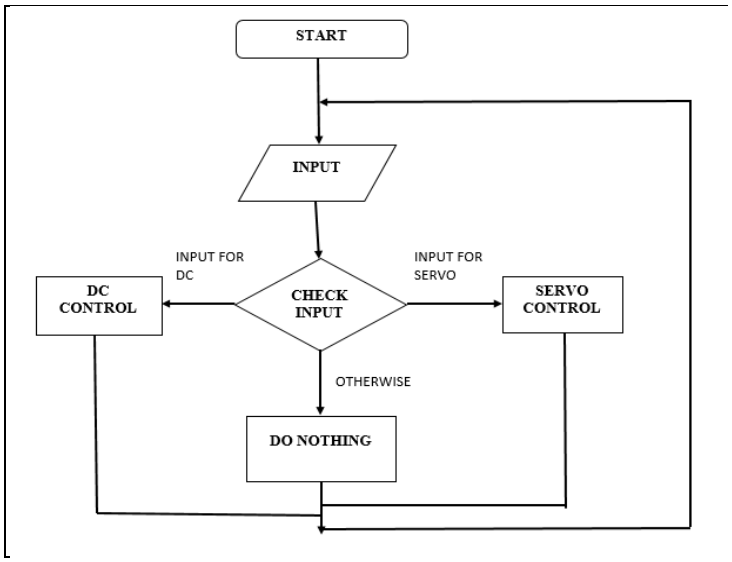

Figure 3: Flowchart of working

Online compilers are available for the coding of freedom board. The code is written in C language making it easier. Firstly the coding is to be done for dc and servo motor since they are the main modules of coding. Separate software is also designed so as to make it user friendly. The user will give commands from this software. It basically simulates the moving of robot and the movement robotic arm.

While starting on Saarthi it is advisable that the dc motor should be first coded. These motors will decide the movement of robot i.e. forward, reverse, right, left.

After this servo motor should be coded. Once both the motors are controlled coding should be done for arm. The basic function of arm is picking and placing the objects so accordingly code should be written.

First the machine is started and all devices are activated. The input is given to freedom board through the laptop via WiFi. This input is checked at the freedom and it is decided whether the input is for dc motor or servo motor. After it is decoded only one type of motor works at a time. So if it is the input for dc motor the robot will move forward and backward and if the input is for servo then the robotic arm is controlled.

WiFi interfacing is also a prime task since all the commands are given via WiFi. The range of WiFi is 2.4GHz to 5GHz. Standard 802.11 b is used for operation and 802.11 g is used for security. For setting up WiFi first switch on the module and enter the module's IP address in a browser. Then the module is to be set in WiFi (serial)-client mode. Then scan to find the WiFi connections in the area and change the baud rate to 9600 and apply all these settings. After this a search for new IP address is carried out on the serial connection software. For setting up WiFi some hardware connections are to be carried out. The serial tx and rx of WiFi module are connected to the tx and rx of freedom board respectively.

3. Results and Discussion

Saarthi is still in development stages. The implementation of WiFi interfacing, servo motor interfacing, DC motor interfacing, power switching, battery level indication and live feed is done.

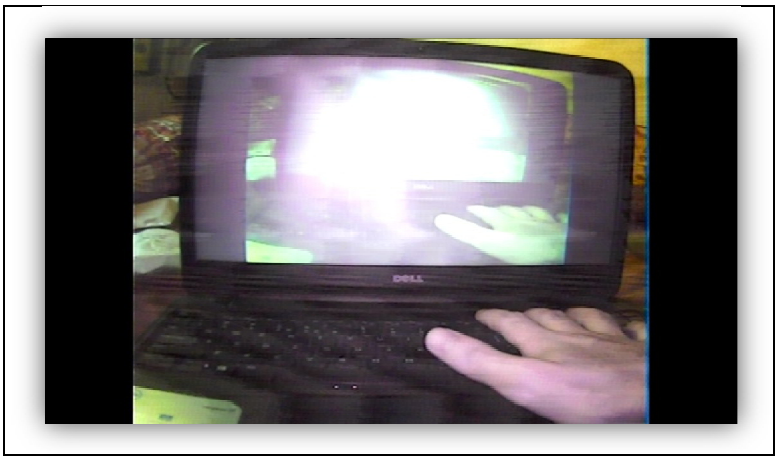

Figure 4: Photo of live feed obtained via WiFi

The work is going on solar and also on making the chasey and PCB. The design of body is almost completed.

4. Conclusion

Saarthi is multitasking robot. Where ever the human efficiency reduces Saarthi steps up and completes the work with very high accuracy. Its main task is surveillance. The robotic arm which is given to it can perform different tasks of regular arm e.g.: picking up objects, changing the control settings, switching on and off machines etc. It works on solar energy but it can also be used at night because of the backup battery provided. This makes it usable during the day as well as the night. The camera on it helps in surveillance. As it works on WiFi the range which is available is also high comparatively. It is operated via laptop through software which is user friendly. The user can view the footage and operate the robot simultaneously.

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