



e-Yantra Robotics Competition Plus (eYRC+ Pilot)

Implementation Analysis - Caretaker Robot

<eYRC+#925>

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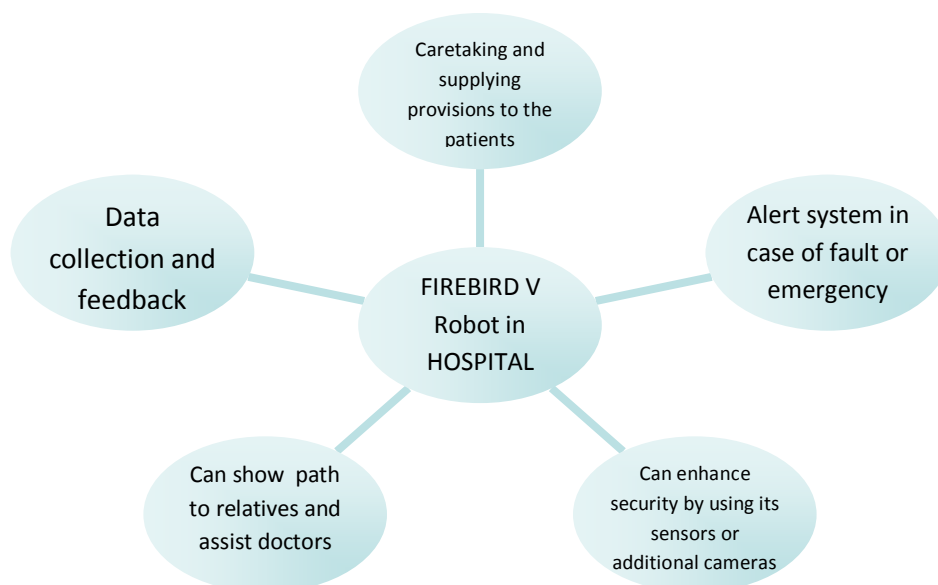
Scope

(5)

Q1. State the scope of the theme assigned to you.

Theme of the task assigned to us is Caretaking by the help of Robotics. The provisions are identified by the robot and supplied to the patient requiring it in the hospital. Not only in the hospital but the conclusion can be applied anywhere where the human intervention can be avoided like household, small scale industries.

As the name of the task signifies, caretaking is with regard to the patients but many other applications can also be applied in the hospital as shown in the diagram.



Building Modules

(5)

Q2. Identify the major components in your robotic kit required for designing a solution to the theme assigned.

Classification of the kit into various systems is as follows:

- 1) **Mechanical System and Power management:** mainly count Power sources, motion actuators (dc geared motors, position encoders), rpm count. It is necessary so as to provide motion to the bot and platform to the electronic system.
- 2) **Electronic System:** Firebird V robot works on ATMEGA2560 microcontroller and other additional ATMEGA8 (for sensing purposes), LCD interface etc. All the functions and booted programs are controlled by microcontroller
- 3) **Communication System:** Constitute wired or wireless communication, Zigbee module for wireless communication, USB for program loading and pc interface, RS232 port for serial communication.
- 4) **Sensing and indicating components:** IR sensors, white line sensors, current sensor, Led and buzzers provide necessary data continuously for performing the task properly.

Communication

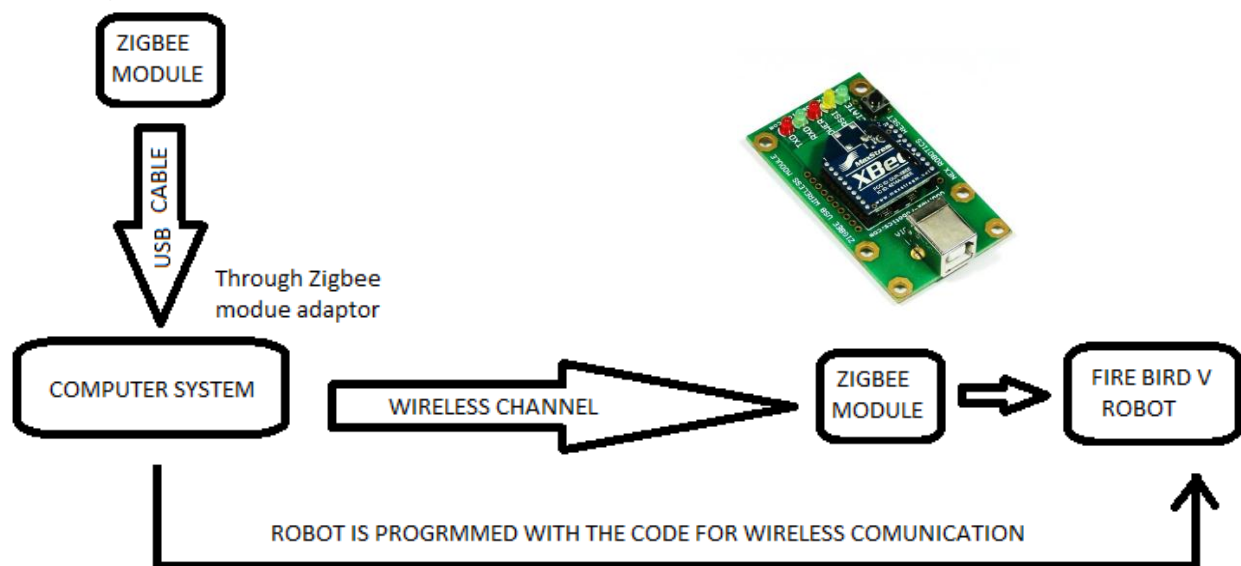
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Q3. Describe the method of communication between the computer and the Fire Bird V robot. Please draw a block diagram illustrating the same.

Method of communication between computer and Fire Bird V robot is wireless communication through zigbee module. Zigbee module is connected to the computer through zigbee module adaptor and USB cable.

The microcontroller is programmed with the zigbee wireless communication code. The robot communicates with zigbee module located on the robot adaptor board with the one connected with robot.

Block diagram:



Environment sensing

(10)

Q4. Explain the functioning of environment sensing technique used by you.

-Environment Sensing: It is a task performed by the robot wherein robot (detects) senses the location of the things like obstacles, sounds, color, signs etc. present near it by using its sensors.

-The Fire Bird V robot is provided with IR sensors (Sharpe IR rangars and IR proximity sensors), white line sensors, and Current sensor (for detecting if there is excess current)

We shall use the following sensors for the caretaker robot theme—

- 1) **IR sensors** - 8 * IR sensors are provided all over the circumference. These throw infrared radiations which are received back by the sensors proving that there is an object.
 - In this task robot senses the object as well as its distance especially in the blind spot of sharp IR and make the appropriate decision.
 - In the front there are Sharpe IR sensors which are capable of detecting long distance obstacles by measuring the angle of reflection. These will be helpful in detecting objects and making decisions beforehand.
 - **Ultrasonic sensors** can be used at place of sharp IR sensors to measure distances by measuring time taken for waves to reach back.
- 2) **White line Sensors:** Placed as the bottom to detect the white line and white surfaces. These help robot to locate itself and follow white surfaces. It the task these sensors can be helpful as it will help the robot to keep itself inside the arena.

Power Management

(5)

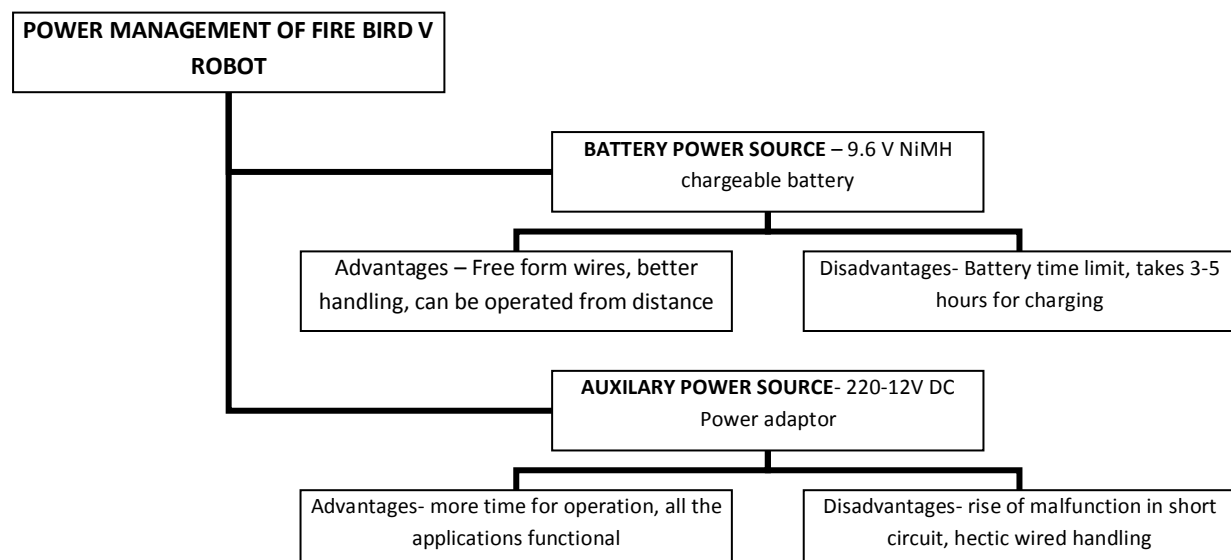
Q5. Explain the power management system required for a robot in general and for Fire Bird V robot in particular.

Power Management of Robot: Fire Bird V robot can be operated from two power source mode.

- 1) **Battery power source:** 9.6 V Nickel Metal Hydride (NiMH) chargeable battery pack.
- 2) **Auxiliary Power Source:** Robot connected to the source via 220V - 12V, 1 A power adaptor.
- 3) **Battery Current sensing:** This sense if there is excess current and stop battery charging and notify by buzzer sound.

-We would prefer to use Battery power because it will free the robot from wires and we can operate it from a distance. Moreover it will help us debug problems in the field applications as there it can only be operated on battery.

-Auxiliary source can be used but when battery is not functioning.



Navigation Scheme

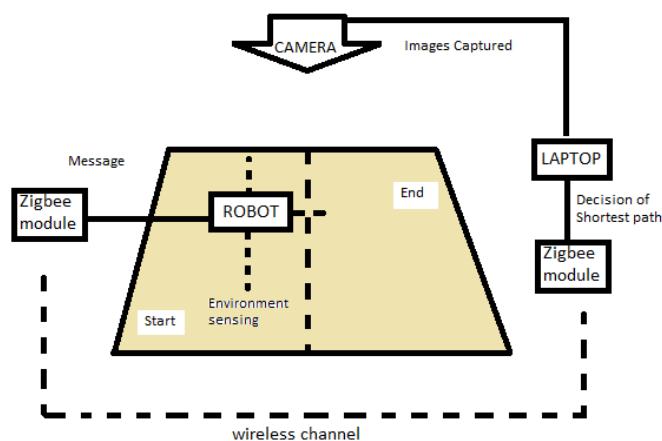
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Q6. Explain in brief the basic navigation technique for path traversal in the arena. Explain the concept and list the components required for basic navigation.

- The robot perform the task of carrying the provisions to the patient's cupboard as required by the patient. During the path traversal it should avoid all obstacles and notify through buzzer and LEDs as mentioned in the rulebook.

- The basic components required by the robot are-

- 1) Motors – provide motion to the bot, allows movement in every direction as per the path.
- 2) Sensors – helps to avoid obstacles in the path, sensing the provisions marker and cupboard marker etc.
- 3) Code for the shortest path generated through python and OpenCV.
- 4) Wireless communication for giving instruction by using Zigbee module.
- 5) Camera – detecting position of robot, start and end point.



Testing your knowledge (Based on theme and rulebook)

(10)

Q7. Explain in your own words how the robot will avoid the obstacles in the arena.

- In the hospital arena the obstacles mainly include walls. The bed may also obstruct the bot while traversing. The robot will use the **environment sensing** technique to detect and avoid the obstacles in the arena.

-The bot is equipped with Sharpe IR sensors which can detect any obstacle and its distance in its range. This will help the bot to choose different path where there is no obstacle in its range.

- There are 8 IR sensors provided all over the circumference of the bot which can detect any obstacle within the range of 10cm. This can easily detect nearby wall and beds and help the bot to follow right direction.

- Moreover the **images from camera** can help the instructor to instruct the bot according to the obstacles and provide the shortest path.

Q8. Explain how you will find the best path to follow.

- Image processing can be used to get the best path for the robot to complete the task. We shall use **python, OpenCV** for the image processing.
- The overhead camera in the arena is connected with the laptop and provides images of the arena. We can get the position of the robot, start, end point and get the best path for the following task.
 - 1) **Start** - Picking up the provision as requested by the patient.
 - 2) **Image processing** - Shortest path avoiding the obstacles.
 - 3) **End** - Delivering the provision to the patient's cupboard.
- The laptop communicate with the robot through Zigbee module at the both ends. This will instruct the robot to follow the shortest path and complete the task.

Challenges

(5)

Q9. What are the major challenges that you can anticipate in addressing this theme?

Major Challenges that we can face during the theme anticipation are as follows-

- 1) **Improper image response from the camera** – If the camera gives images that changes in terms of contrast, gamma effect, color response etc. code may show error and improper results. It can be avoided by using proper lighting and orientation.
- 2) **Code error in field practice** – Code which may look proper on the computer may show errors on the arena. This can be avoided by designing the code keeping practical view into consideration.
- 3) **Dis-orientation of the robot** – Bot may get dis-orient due to improper reading from the sensors due to variable distances. This can be avoided by proper handling and keeping in view the range of robot.
- 4) **Power Problems** – Auxiliary power may show improper responses like excess current, this can be avoided by pre-checking the sources.
- 5) Any unknowing problem may occur on the arena but these can be **avoided by taking proper care and pre-checking every possible thing.**