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Multipurpose Humanoid Robot

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ABSTRACT

Humanoid robots are without question a popular topic in research today. In this work we discussed about design and construction of a general multipurpose humanoid robots. The proposed robot is to develope something like human means artificial intelligence both in term of body and brain (some functions). In this paper we proposed a small approach for body-brain integration. The proposed robot can be used in civil as well as in military fields. The design and placement of body (mechanical arms and wheel system), as well as remote controlling mechanism and wireless communication mechanism are discussed here. The co-ordination of its various part is to perform recognize people or objects, human voice, monitor environmental quality, respond to fire alarm and also perform other useful tasks. The movement of robot can be controlled wirelessly. In this robot we have added a Chatbot (by using python programming) for communication with human. This robot can be used for cave investigation and also in education and research field. The structure and design of the proposed robot is adaptive and in cognitive architectures make such a system feasible and can be modified to enhance its capability to further level.

Keywords

Humanoid Robot, AI Agent, Multipurpose Robot, Wireless, Face Recognition, Surveillance.

1. Introduction

Robotics is a branch that includes many branches of engineering and science including mechanical, electronics, computer science artificial intelligence, digital logic, nanotechnology and bioengineering and so on [4]. Often Some Robots are built to enhance the hardware design problem from practice and evaluation through numerous competitions including the Darpa Robotics Challenge, the Amazon Picking Challenge, and other competitions that were held in Japan [1]. Humanoid Robot introduces a multi-purpose natural language understanding framework that processes human spoken utterances and generates planner goals as well as symbolic descriptions of the world and human actions [2]. Presenting Tombatossals, a multipurpose humanoid torso, for research of autonomous grasping and manipulation tasks in unstructured household scenarios. The actuators, sensors, and computer, software architectures are described here. Moreover, the robot current abilities of the robot, including perception, manipulation and task execution, are also discussed. And, in this paper also summarizes many projects and experiments showing the system capability [3]. A general multipurpose robot is developed and tasted for detecting gas leak in home or industry, parking lot, surveillance of shopping mall, industry, office,

bank, museum etc., The helping rescue operation for supplying food as well as during natural disaster. It can also perform military surveillance like exploring unknown enemy territory, spying enemy base, night security [4]. A robotic ball-catching system is built from a multipurpose 12 DOF four-fingered hand (DLR-Hand-II) is presented and a 7-DOF lightweight arm (DLR-LWR-III) is also presented [6]. Some Robot describes a control and a structure of a battery driven 'bipedal robot, which has a 6-DOF structure parallel mechanism. It has been designed.as a multi-purpose locomotor system of robotics. This robot is controlled by using the QNX real-time OS. A walking control is proposed and tested indoors and outdoors [5]. A Robotic Assistantis is developed to perform the operations according to both gesture and voice commands. The operations in RoboticAssistant are move left and right, backward and forward. The Robotic Assistant can pick and release objects too [7]. A robot is a machine, programmable by a computer, capable of carrying out a series of action according to instruction. The robots which have taken the form of human appearance may walk like humans, speech, cognition and most importantly all the things a human can do.

Figure1: Full Picture of the Robot

The objective of this work is to design and construct a multipurpose humanoid tactical robot which can do dedicated and also for general purpose works. In dedicated part it can be used for cave investigation, education purpose, in military for surveillance purpose, to carry the light weight object and research. In general purpose work it can recognize people, can communicate with human, can detect the objects and also sense several environmental parameters (fire detection, color sensing etc). The full picture of the robot is shown in Figure1.

2. Working Principle

In this project the Chatbot Python program is used for communication between a person and robot and other main components, design considerations and block diagram to develop proposed robot are described below.

2.1 Block Diagram

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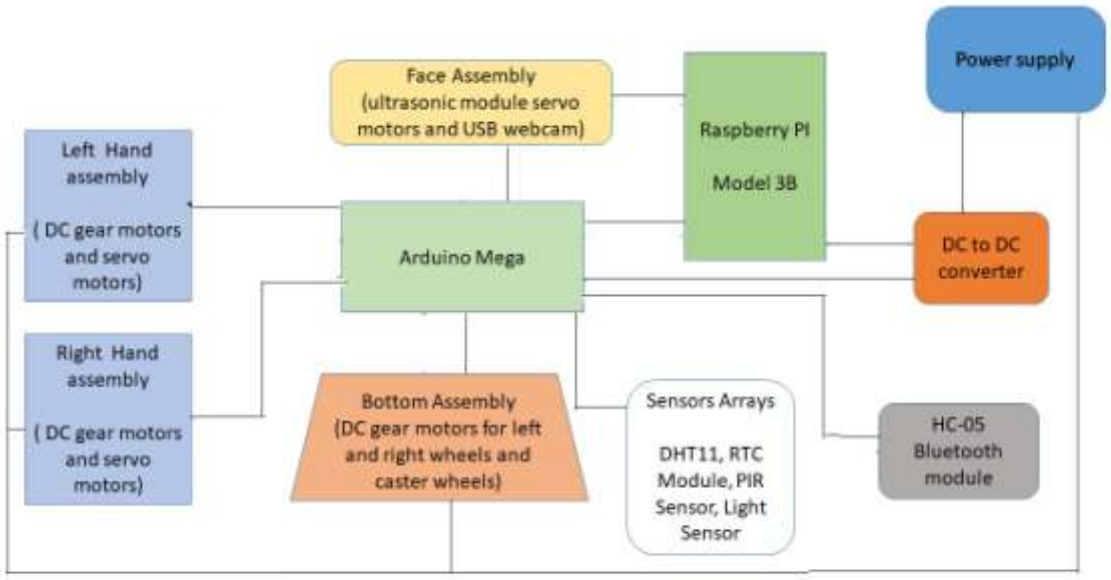

Figure2.1: Block Diagram of the Robot

2.2 Robotic Body

The most challenging part is to design the robotic body. The design of the body of a robot depends on its purpose or field of application [4]. Two Jonson DC gear motor is used for left, right, backward, forward movement. For the hand and neck joints movement's servo motors are used. The wheel based system is used to move the robot indoor as well as outdoor fields. The body of this robot is made like a human body.

Figure2.2.1: Upper Body Part

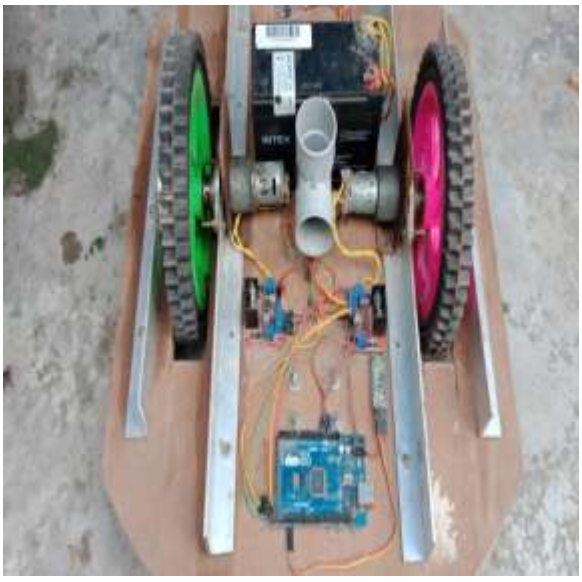

Figure2.2.2: Lower Base Part

2.3 Control Unit

Control Unit of the proposed robot consists of Arduino Mega. It can be programmed with a simple Integrated Development Environment (IDE) that runs on regular personal computers and allows writing programs for Arduino using C or C++.

Arduino Mega communicates with Raspberry Pi board and with Bluetooth Module (HC-05) By using it's serial ports 0 & 1, Robot can be controlled directly by using a android smart phone connected with it by Bluetooth communication. To control the robot we need to download the app, connect the smart phone with the robot and feed the following table data for the required operation:-

Table1. DC Motor Rotation

Serial Port Input Data	**Movement**	
	Motor A (Right Side)	**Motor B (Left Side)**
f	Clockwise	Anti-Clockwise
B	Anti-Clockwise	Clockwise
L	Anti-Clockwise	Anti-Clockwise
R	Clockwise	Clockwise
S	Stop	stop

Table2. Servo Motor Rotation

Serial Port Input Data	**Servo Motors**					
	Servo 1	**Servo 2**	**Servo 3**	**Servo 4**	**Servo 5**	**Servo 6**
Yes	Active					
No		Active				
rud			Active			
lud				Active		
rej					Active	
lej						Active

rud → Right hand up and down lud → Left hand up and down

rej → Right hand elbow joint lej → Left hand elbow joint

2.4 Processing Unit:

The core and main processing unit consist of a Raspberry Pi board. The Chatbot.py program is used which is written in Python IDLE runs in the Raspberry Pi board. The Face Recognition program is also written in IDLE. Face Recognition is done by using The Web-Cam which is connected to the Pi board. The speaker is also connected to Raspberry Pi. To configure the Raspberry Pi board we can use either a external monitor and

keyboard or download the VNC Viewer app in our smart phone or in computer and then input name and password of Raspberry pi in VNC Viewer app and now we can see the pi desktop screen.

2.5 Flow Chart

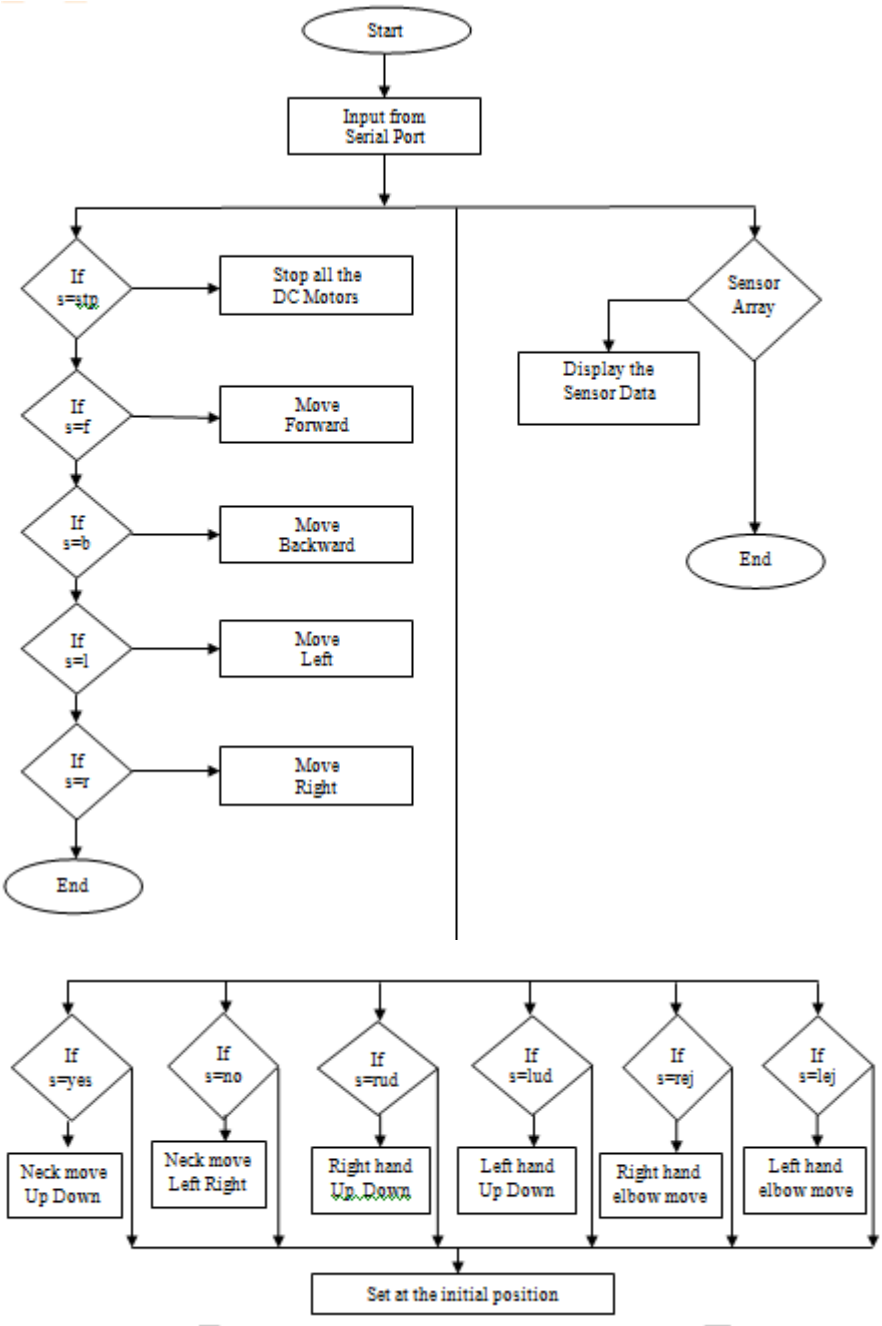

Figure2.3.1: Flow Chart of the Motors and Sensors

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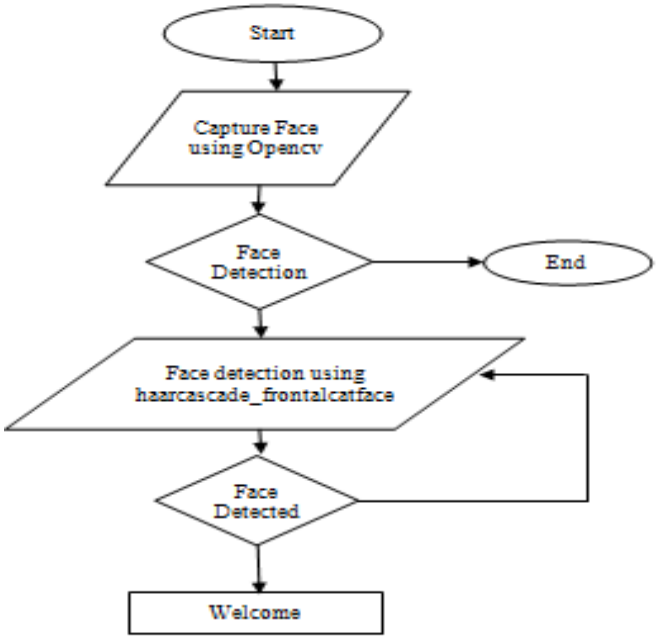

Figure2.3.2: Flow Chart For Image Recoginition

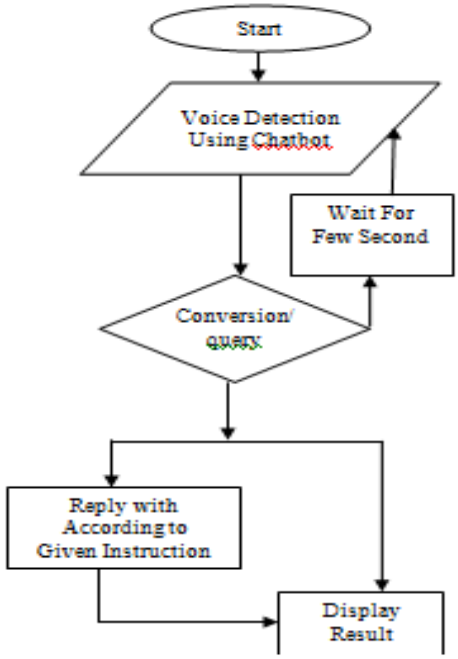

Figure2.3.3: Flow Chart For Chathot Progrm

3. Result

The design procedure and the construction of the robot is discussed above. The Height of the robotic body is 146 cm (Figure-1) and the total weight is 13.2 kg (Figure-1). The dimension of the upper part is, Height = 63cm, Width = 28cm (Figure2.2.1). The dimension of the lower base part is, Length = 55cm, Width = 50cm (Figure2.2.2).

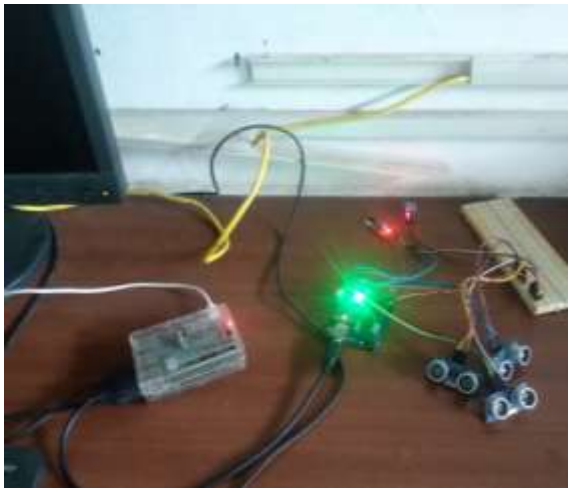

Figure3.1: Multiple Sensors connected with Arduino

Figure3.2: Sensors Output at the serial port

nsors

are shown at the serial port. In the Figure2.3.1 the working of DC Motors, Servo Motors and multiple Sensors

are shown. In Figure2.3.2 the working of Image Processing using USB Webcam and raspberry is shown, the result is displayed at the python interpreter. In Figure2.3.2 the working of chatbot program is described.

Now we discuss about power consumption, the power consumption is an important factor for the robot because if we want to sent the robot to explore an unknown cave or tunnel, then there should be a good power backup so that the robot can come back to its initial position after finishing its job.

Table3: Power Consumption of the main components of the robot

Name of Component	Voltage and Current Rating	NO. of Unit	Power Consumption /unit (watt)	Net Power (watt)
Raspberry Pi 3b	5v,1.4A	1	7W	7W
Arduino Mega	5v, 75mA	1	0.375W	0.375W
USB Webcam	5v, 216mA	1	1.08W	1.08W
Blutooth Module(HC-05)	5v, 25mA	1	0.125W	0.125W
DC gear Motor	12v, 1.5A	2	18W	36W
Servo Motor	6v, 600mA	6	3.6W	21.6W
Motor Driver(L298)	12v, 2A	2	24W	48W
Motor Driver(PCA9685)	6v,2.5A	1	15W	15W

Total Consumption = 129.18Watt ≈ 130Watt

Let us assume active run time is t and the depth of discharging is 80% .

Used Battery voltage = 12v, Battery Rating under use = 7.5Ah, Numberof 7.5 Ah Battery = 1

The formula for the active run time is givenby

$$= \text{Number of 7.5Ah Battery Required} \times \text{Battery Rating under use} \quad [4]$$

Now on putting the values in above equation, we get

$$= 1 \times 7.5$$

$$t = = 0.5538 \approx 0.6 \text{ hour (36 minute)}$$

So after full charging the robot will work 36 minutes (3/5 hours).

4. Advantage:

- It can explore an unknown cave or tunnel where a person cannot be sent directly due to potential risks.
- It can directly communicate with human and follow the given instructions.
- The robot is automatic so it can be move itself without any human interference.
- Repetitive jobs that are boring, stressful or labor-intensive for humans.

5. Disadvantage

- Due to two wheels drive system it can't run on very ruff surfaces.
- Slow processing due to limited calculation power of Raspberry pi board.
- Currently its require a Wi-Fi network for network related operations.

6. Future Scope

- The processing unit can be updated for the faster and more complex tasks y replacing the pi board with Nvidia Jetson series boards or a laptop motherboard with GPU.
- Operations of this robot can be more flexible and precise by upgrading the motors with industrial grade motors.
- Networking capabilities can e enhanced by adding a dedicated VOLTE GSM modem with the robot.

7. Conclusion

In this research paper, we have given you an explanation about multipurpose humanoid robot .which we have implemented for multitasking. We explained all the hardware, software and all implemented skills used in this project. In this project we have made a multipurpose humanoid robot by working the drawback like single tasking. In this work we discussed wireless communication and remote controlling in details. After constructing the robot, it was tested as to carry the light weight object, to recognize people, color sensing, fire detection, human voice recognition and for surveillance purpose. Tested after project build as discussed design and found to work well. The proposed robot's structure is adaptable and can be modified. Robots will really change the future of mankind. Robots is one of the biggest revolutions in the process industry. Robotics automated tools will be highly effective in the times to come. Robots design maker and design will rule the world. In our project we can improve this by replacing processor Raspberry Pi 3b because there are processing problem occurs when voice and image recognized and also improve by adding functions like GPS sensing, control units and home automation.

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