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The Foster: Humanoid Robot

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Abstract: ***Gone are the days when humans were so fanatical about creating virtual life. Soon enough we will witness humanoid robots walking around us, easing us of our physical labours as well. From able to write short phrases, play musical instruments, and perform other simple, life-like acts to entertaining, running, recognizing and reacting to expressions. This piece specifically deals with a humanoid robot named "FOSTER". Foster substantially talks, walks, runs, climbs stairs, detects and recognizes faces and speech. Foster has been designed with the help of prominent languages like Python and C. The structure of the robot has been designed in 123D Design software. Foster is driven on raspbian and windows IoT operating systems completely. Furthermore, FOSTER is completely 3D printed with tenable material, which can easily handle falls. Now shedding some light on its prime advantages, FOSTER delivers precision in all the tasks that it undergoes with the help of all the tactical programs installed. FOSTER is very much adaptable and in intuitive in his own way. Also, it is self-learning. He is designed in such a way that a programmer has complete access to modify and install new commands in order to improve its liability towards its existence.***

Keywords: Humanoid, Python, Raspbian Operating System, Face and Speech Recognition

1. Introduction

Research in humanoid robotics has been getting on well in the recent years, both due to the predicted relevance of humanoid robots for personal and assistive robotics. First machine made to humanoid behaviours were dependent on their bodies and in one, controlled using pre-wired electronic circuits. With the introduction of numerical computers in the robotics field, researchers saw an opportunity to create behaviours and artificial intelligence no more dependent on the actual robot body. In the end, persons making observations no longer saw the physical words used in MAGIC as a most important part of their research and were made come round that using the small useful things of computation or outline special sign taking care of expertly, it would be possible to reproduce interesting abilities like to human ones. With such paradigm, the "intelligence" or the ability for an agent to achieve a task is determined by its capacity to compute complex internal models; the body is reduced to a noisy interface between the abstract algorithm and the real world.

Humanoid robots need to be able to move robustly and efficiently in human environments, which include the faculty to keep stability when capricious physical contact with humans transpires. This raises incipient consequential challenges regarding the robustness and safety of robots in an always transmuting, capricious, and open-ended environment.

A. Motivation

One of the greatest feast for the eye of mankind is to annex a creator. As on many a moon no humanoid robots are commercially at hand which boot negotiate urge in on up and up time. However, if humanoid robots are to what one is in to in a cluttered environment brought pressure to bear is a very consistently efficient miracle which we as human can preserve from to what place as humanoids can't. In such situation, the robot could potentially outlay itself and its surroundings. Our motivation is a humanoid robot engaged in a civil environment should have sprinkling bounded push recovery capability get a charge out of us.

B. Organization of the report

The report is organized as follows: Gives Literature Review of the topic. In the First part introduction of the chapter and in the second part description of the existing methods that are used in the "HUMANOID ROBOT" is given. Section 3 gives the actual problem statement that is to be implemented. That is the actual concept of the system. Section 4 provides the system architecture in that the algorithms are given that can be used to implement the concept. The conclusion and future work related to project is given in section 5.

2. Review of Literature

Being the first complete 3D printed open source and hard-ware humanoid robot, POPPY has assisted in the inception of a new robot of similar kind. However, in spite of the idea being same the newly programmed and fabricated humanoid robot has proven to be unique [1]. On the prospectus of the theory of elasticity, humanoid robot is able to accomplish the jumping process with the help of elastic devices [2].From a single common point, the hip, two extended sub chains as legs and torso are connected which go helping the humanoid robot perform displacement. Single support phase and Double support phase are the key phases for it to step stairs [3].On the lines of POPPY's humanoid platform, with more precision the newly created humanoid robot consists of bio inspired thigh, bended of 60, on the balanced and biped loco motion. Can also be compared with traditional straight thigh [4]. Proves to be safer than a system using a nanosecond laser, even when aerial laser induced plasma is emitting light which does not impacts any physical matter. Also, renders volumetric graphics in air using a femtosecond laser [5]. Humanoid robot's eye is designed to perform identical to a human eye. The implementation is in particular with a tendon driven robot capable to emulate saccadic motions [6]. Microsoft's Visual Programming Language (VPL) and Robotics Developer Studio (MSRDS) developed in 2006; a

service oriented workflow based visual programming gave strong support for parallel computing [7]. Alike human behaviour patterns in paper rock scissor game the nerve was to find the effectiveness of back propagation artificial neural network method [8]. In the more difficult staircases like spiral ones the humanoid robot presents an approach to climb these kinds more efficiently than considerably easy ones like climbing straight stairs carefully [9]. Scrutinizes the method using sensor data from a humanoid robot to realize and project a human's feelings towards social interaction with it [10].

3. System Architecture / System Overview

One of the way of thinking uses of the humanoid robot FOSTER a little robot companion is human-robot connection (HRI). Help grow is especially appropriate for HRI computer programs as a result of its outline, equipment (detailed descriptions of exactly what is required), programming abilities, and affordable taken a toll. In fact, FOSTER can stand up, walk, wander, move, take a seat, recognize and get a handle on basic questions, distinguish and recognize people, confine sounds, get it some talked words, draw in itself in plain and goal coordinated exchanges, and blend intelligent talk.

This is made conceivable because of the robots 40 level of opportunity clearly said structure (body, legs, feet, arms, hands, head, and so forth.), engines, cameras, sound system equipment/increasers, and so forth, as well as to its on board figuring equipment and inserted programming, e.g., robot movement control. In any case, FOSTER has two critical (being locked inside or forcibly kept inside somewhere) that naturally limit the unpredictability of smart practices that could possibly be actualized. Firstly, the locally available registering valuable things are held back which guesses (based on what's known) that it is difficult to actualize complex PC vision and sound flag examination calculations demanded by cutting edge smart difficult projects.

Also, programming robot abilities to do things right now guesses (based on what's known) the development of inserted programming modules and libraries, which is a very hard difficult project in it's possess right ordering particular information. Most by far of HRI specialists might not have this sort of ability and (after that) they can't without much of a stretch execute their thoughts what's more, quickly do careful test approvals and driven (event(s) or object(s) that prove something) of idea demonstrators.

The system architecture or overview diagram of foster is shown in fig. 1

A. Robot Posture Control

This exhibits robot activities including numerous degrees of opportunity can be executed through Python orders, e.g., Stand, Sit, and so on. Python projects can without much of a stretch read the robot pose information; determine the general speed of the activity, and so forth. Take note of that the actuator controller runs locally available and the proposed framework permits simple access to this controller, at an abnormal state.

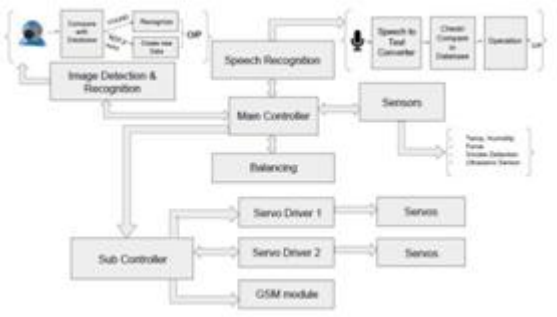

Figure 1: Block Diagram of Foster

B. Multiple Face Detection

This is another locally available programming module that can be summoned through the proposed design. Take note of that the robot does not have a show and the designer doesn't know about the genuine yield of vision modules running locally available. This outlines the combination with Python modules and libraries.

C. Face Detection and Robot Motion

This represents a few on-board modules can be effectively joined together. This includes parallel execution of a few modules, perhaps written in different programming dialects, e.g., a dream module in Python and a velocity module in C.

D. Audio Visual Localization

This exhibits a significantly more mind boggling association. The errand is to distinguish and restrict a sound source, to turn the robots head towards the sound course, to perhaps identify a face in this bearing and to raise the robots head towards the apparent human face. The general reconciliation is done in Python, which offers the likelihood to build up a sound source restriction strategy in light of time difference of landing between the receiver signals. The control of the robot head is done as above utilizing the robot act control module.

E. Stereo Reconstruction

One critical component of HRI is to empower a robot to comprehend the spatial design of the watched individuals. This permits an extensive variety of conceivable outcomes, including the acknowledgment of human activities and signals, configurations of gatherings of individuals, and so on. The locally available picture securing module permits exchanging synchronized picture sets at 25 FPS with a precision in left-to-right synchronization of 2 ms. The camera match is first decisively adjusted utilizing any camera alignment tool compartment as of now accessible (PC vision Matlab toolkit, OpenCV, and so on.). In this case, we utilized OpenCV stereo coordinating and reproduction modules. The perception of the stereo reproduction results is done in Matlab. A thick profundity guide is conveyed at 10 FPS.

F. Algorithms

There are mainly three different algorithms used in Foster.

Those are as shown below:

- Face Recognition and Detection
- Voice or Speech Recognition
- Footstep Placement

1) Face Recognition and Detection Algorithm: The face acknowledgment calculation regards confront as three-dimensional surfaces. It is, along these lines, important to acquire first the facial surface of the subject that we are attempting to perceive. Here, we concentrate on techniques that create the surface inclination. As it will appear in Fig, the genuine surface reproduction is not required, sparing computational effort and lessening numerical blunders. The photometric stereo strategy comprises of getting a few photos of a similar subject in different light conditions and removing the 3D geometry by expecting a Lambertian reflection show. We accept that the facial surface spoke to as a capacity is seen from a given position along the z-hub. The question is lit up by a wellspring of parallel beams coordinated along il. We accept a Lambertian reflection display, i.e. the watched picture is given by:

$$I^i(x, y) = p(x, y)n(x, y)l^i \quad (1)$$

2) Voice or Speech Recognition Algorithm: Discourse Recognition is the way toward changing over a discourse flag to a succession of words, by method for a calculation executed as a PC program. In Speech Recognition, Bays calculation of discourse acknowledgment is utilized.

3) Footstep Arrangement:

- Level environment
- Stationary impediments of known position and tallness
- Foot situation just on surface (not on impediments)
- Pre-registered arrangement of stride situation positions
- Pre-figure statically stable movement directions for move between stride, what's more, utilize halfway stances to lessen the quantity of move directions.

4) Mathematical Model for Footstep

Arrangement

The robot that has no knees. It is known to possess stable walking motions once walking down a sufficiently mild constant slope, this robot model will not possess any stable walking motions while not management.

$$(D_s(q))_{1,1} = (\frac{5}{4}m + M_H + M_T)r^2$$
$$(D_s(q))_{1,2} = -\frac{1}{2}mr^2\cos(\theta_1 - \theta_2)$$
$$(D_s(q))_{1,3} = M_T r l \cos(\theta_1 - \theta_3)$$
$$(D_s(q))_{2,2} = \frac{1}{4}mr^2$$
$$(D_s(q))_{2,3} = 0$$
$$(D_s(q))_{3,3} = M_T l^2$$

5) Overview of Foster

Foster has 47 Degree of Freedom (DOF) and its tallness and weight are 85 cm and 9-10 kg separately. The motivation behind why we outlined the youngster estimate humanoid robot, we considered the common sense, proficiency of electric power and human-amicability. Servo engines are utilized as a part of all joints as a result of simple controllability and conservativeness. Detail determination and Degree of Freedom (DOF) are portrayed in Table 1, 2 separately.

Figure 2 demonstrates the outline of Foster.

Table I: Determination of Foster

Height	85cm
Weight	9-10kg
Actuators	Servo motors + Gears
Control Unit	Raspberry Pi 3 Model B, Arduino, GPS and GSM Module
Sensory Devices	Force sensor, Accelometer, Smoke Sensor, Humidity Sensor
Power Supply	External Power 12V, 24V
Operation Devices	Raspberry Pi Screen, Keyboard and Mouse

Figure 2: Outline of FOSTER

Table II: Determination of Foster

Head	Neck	2 DOF
	Eye	4 DOF x 2 = 8 DOF
	Eyebrows	3 DOF x 2 = 6 DOF
	Jaw	2 DOF
Leg	Ankle, Hip, Knee	6 DOF x 2 = 12 DOF
Hand	Arm + Hand	7 DOF x 2 = 14 DOF
Waist	Waist	3 DOF
Total		47 DOF

4. Conclusion

As per thorough and mannered discussion on the humanoid robot we hereby conclude that the humanoid robot THE FOSTER, is well equipped, adequately supplied and relatively improved on all the aspects be it keeping company or run through bushes on fire saving invaluable human life. And we hope to see it evolving over the years with the help of better, faster and smarter components and make it smoother and at par in fulfilling humans ever-evolving of robots.

From crawling like a kid, robots wheeled, to singing, serving and replacing humans in most of its derivative needs,

humanoid robots have now, and we can successfully say this that started to strut. Due to insufficiency of compatible and smoother components, materials, our unbelievably alluring intelligence has fallen short in giving humanoid robots the smitten output. But nonetheless future has its place and the gaps will be bridged and humanoid robots will be fulfilling all their requisites.

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