Social Robot

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***Abstract*—Robots have always fascinated mankind. Through the advancement in technology the world has been able to implement Artificial Intelligence to a great extent but we still have a long way to go. In this paper we introduce ZIZO 101, a social robot. It consists of an Radxa Rock board as the development board and Arduino Mega 2560 as the microprocessor. The combination of these with a webcam attached to the animatronic head enables ZIZO 101 to behave as a social robot. The paper also explains detailed hardware and software implementation of the robot.**

***Keywords*—Social Robot,Speech Recognition,Radxa Rock, Arduino Mega.**

I. Introduction

The Radxa Rock is a single board computer shipped with Android 4.2.2 (Jelly Bean) and Ubuntu/Linaro 13.09 dual boot on the NAND flash (on-board storage) developed with the intention to promote teaching of basic computer science in schoolsIt has also been a great prototyping platform for hobbyists and engineers alike. The Arduino Mega 2560 is a microcontroller board based on theATmega. We were fascinated by the idea of a robot interacting with people and doing all that people do to be social. So we came up with ZIZO 101- The social robot. The focus of this project was to construct an animatronic head that had sufficient degrees of freedom to mimic human head movement. As such, six degrees of freedom are havebeenassigned to the robot: fivein the face and one in the neck. From these degrees of freedom, the mechanics of the animatronic head weredesigned such that the neck and facial features can move with the same range and speed of a human being.

II. Motivation behind the project

We were quite fascinated by the idea of a robot interacting with people and doing all that people do to be social. So we came up with ZIZO 101- The Social Robot. Our Social Robot Zizo 101 is capable of interacting with others, showing some predefined emotions on demand, chatting with others through Twitter, tracking the face of the person standing infront of him and capturing images of the surrounding on demand and send it through internet. The idea of making a social robot i.e. an animatronic head which can mimic human head movements was met by the obvious question- What is its use? The social robot can be used to study humanrobot interaction, especially child-robot interaction. Though our model is in its primitive stage, it can be improved upon and made capable of being used to study such behavioral aspects. It opens several doors for us. If implemented, it can be used as a surveillance machine which can be operated over the internet.

III. Background theory

Our social robot requires an internet connection and good amount of computing power and working memory in the single board computer. Radxa Rock was the answer to all our needs as a development board. It has got a WiFi port, LAN port, an amazing quad core processor and 2 GB RAM. Its portable size and light weight was instrumental in keeping our robot compact. It is quite user friendly as it is a linux based environment. Arduino Mega 2560 also provided the ample amount of PWM pins required in or project.

IV. Hardware implementation

A. Mechanical Design

This topic presents the mechanical design of our project. We developed ZIZO101 in AutoCAD Fusion and tested its feasibility in it. ZIZO101 has 6 degrees of freedom including 2 in neck, 2 in eyes and 2 in eyebrows. We have used micro servos to control smaller parts like eyes and eyebrows and standard servo for larger parts like neck movements. One of our main objectives in ZIZO101's mechanical design is to obtain smooth motion, light-weight joints and simple kinematics. All major parts for ZIZO101 are made of acrylic which were cut through laser cutting in 4i-laboratory, IIT Kanpur

We control the eye movements using micro servo SG90 which are controlled by arduino Mega. Eyes were designed such that they can rotate around z-axis and x-axis so that they can look upwards, downwards and sideward. The eyebrows are controlled by two micro servos separately. We can show some basic emotions like sad, angry, neutral using movements of eyebrows.

As eyebrows are controlled separately we can give some funny emotions like in the figure.

B. Electronic Circuitary

Electronics part mainly deals with controlling the servo motors with the help of microcontroller according to the commands given by the RADXA board to the microcontroller through serial communication.

1) RADXA BOARD: The Radxa Rock is shipped with Android 4.2.2 (Jelly Bean) and Ubuntu/Linaro 13.09 dual boot on the NAND flash (on-board storage) and it works out of the box(Rock Pro is shipped with Android 4.4.2(Kitkat) on NAND flash).

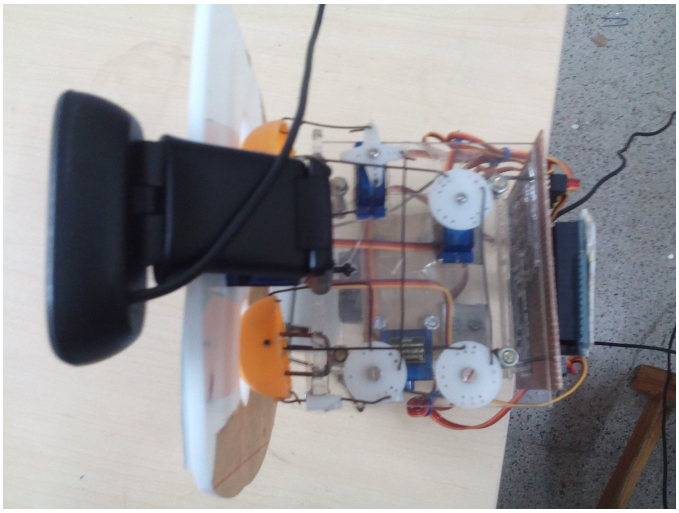

Fig. 1. Top view of eye mechanism.

Fig. 2. Sad,Angry,Normal and funny faces of ZIZO101.

2) ARDUINO MEGA: The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 .It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

We have used ARDUINO MEGA 2560 to control the motion of the 5 microservos and 2 continous servos. The 5 microservos control the motion of the face parts like eyebrows, eyeballs and jaw and the 2 continuous servos used in the motion of neck during the face tracking.

We have python codes for face tracking , expressions and talking uploaded in radxa board .Radxa board sends the data for the motion of the servos to the Arduino through the radxa board in the form of character . Then ARDUINO analysis the data received over radxa board . Now we have our ARDUNio code written in java which moves the particular servo with particular angle according to the data received from serial communication. We have made our circuit compact in GBP(general purpose board) and made all the connections through the Arduino by soldering.

C. Software Implementation

All the code in ZIZO101 is in python. The code mainly consist of three parts.

1) Face Tracking: Open Computer Vision libraries has been used for face detection using Haar feature-based cascade classifiers. Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, ”Rapid Object Detection using a Boosted Cascade of Simple Features” in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. The coordinates of the face are then sent to Arduino Mega through serial communication which then rotates the neck servo as required.

2) Voice Processing: It involves conversion of input voice to text using Google Speech Api V2 which is a online service provided by Google. The Google Speech Api is based on US accent of english and hence it was not very accurate. The string received from Google is then checked for some pre-defined commands and in case there are no commands then we send the string to a online AI database stored on ”cleverbot.com” which then sends appropriate reply after interpreting the string. The reply from the cleverbot is then converted to speech using espeak library which completes the last part of voice processing.

3) handling Twitter Acoount: Tweetpony python api is used to send and recieve messages from the twitter account of ZIZO101. The program regularly keeps checking for any new messsages with a gap of 30 seconds. We also defined a command ’Take’ which would instruct ZIZO101 to take a picture and upload the photo to google drive and send the link to the user.

The entire code is uploaded on github and can be accessed through the link ”https://github.com/ndesh26/ZIZO101”

V. Future Scope

We plan to extend the project to other social networking sites like Facebook.Give face more degrees of freedom thereby

giving more emotions.Improve the efficiency of face tracking algorithm to improve the speed of the reflexes.Improve code so that emotions and replies are expressed simultaneously

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