

Android Head Projects

The most interesting to us Android Head projects from all over the world will be shown here.

I will show also here my previous robot heads build at PSU and in Kyushu Institute of Technology.

As the first I will show in detail the robot head of David Ng which is the best explained and most innovative robot head on Internet.

WE WILL SOON PURCHASE IT

Part One

Robot Heads of David Ng

[David Ng](#) has a [company in Hong Kong](#) which is making android heads for sale to the public.

The head is completely customized to pictures the customer sends in using [3D Studio Max](#).

The skulls are cut with a laser cutter.

The skin is silicone and it even has facial muscles (it can smile and frown).

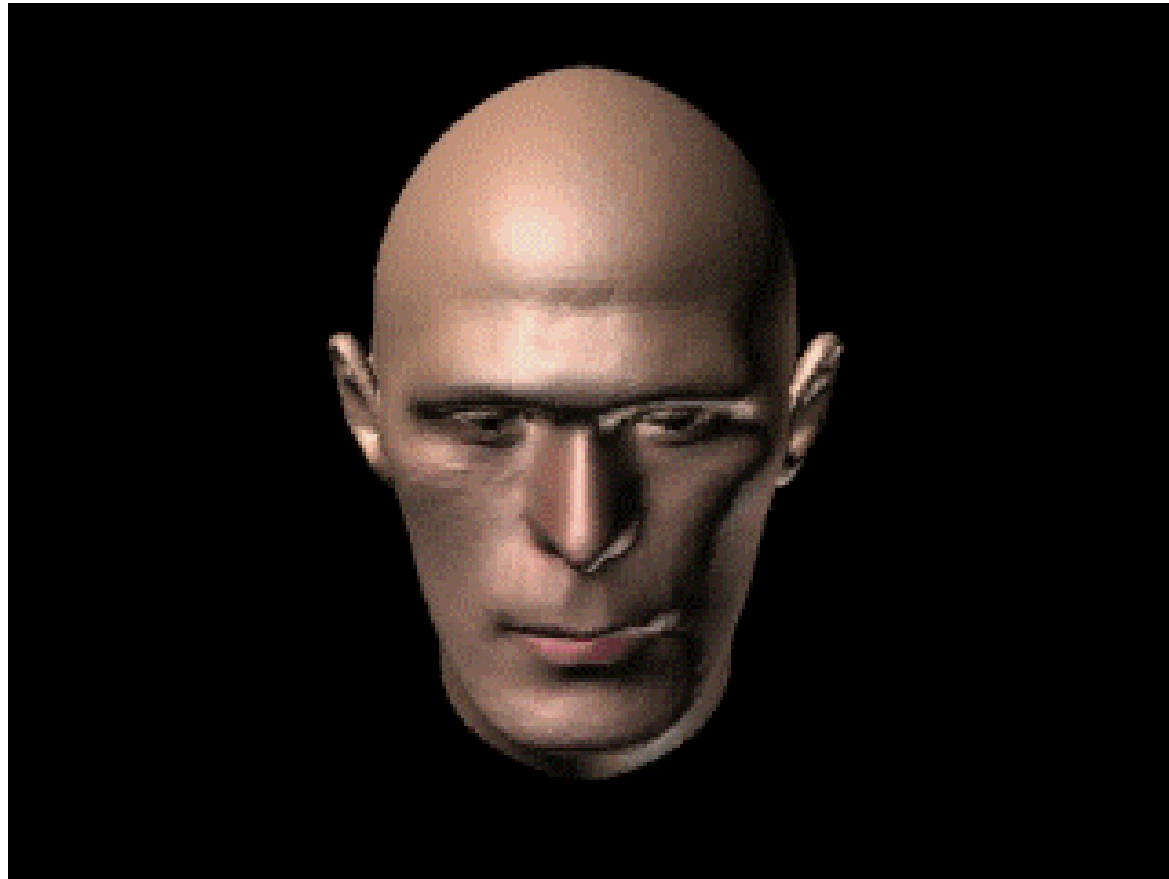
The eyes move too.

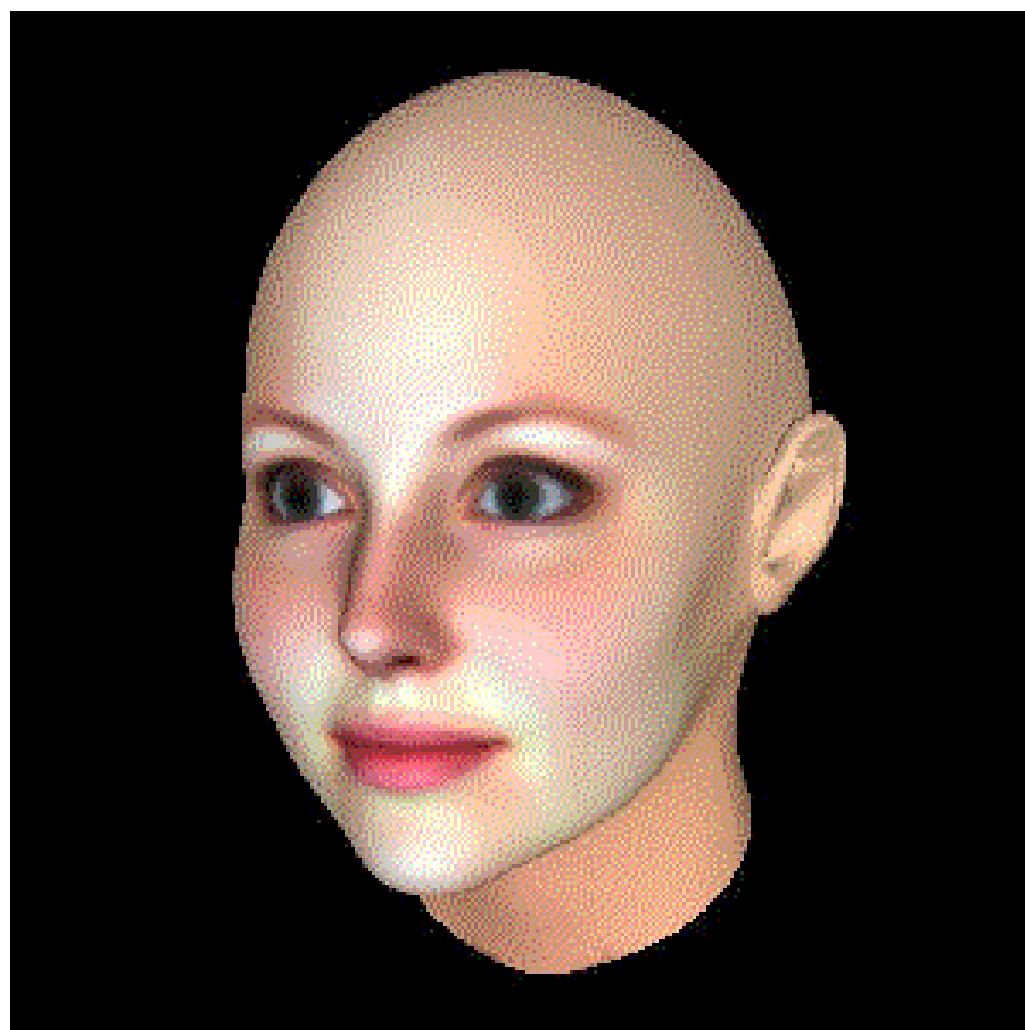
The cost of a head without servos and electronics is \$2000.

With servos it is \$3000.

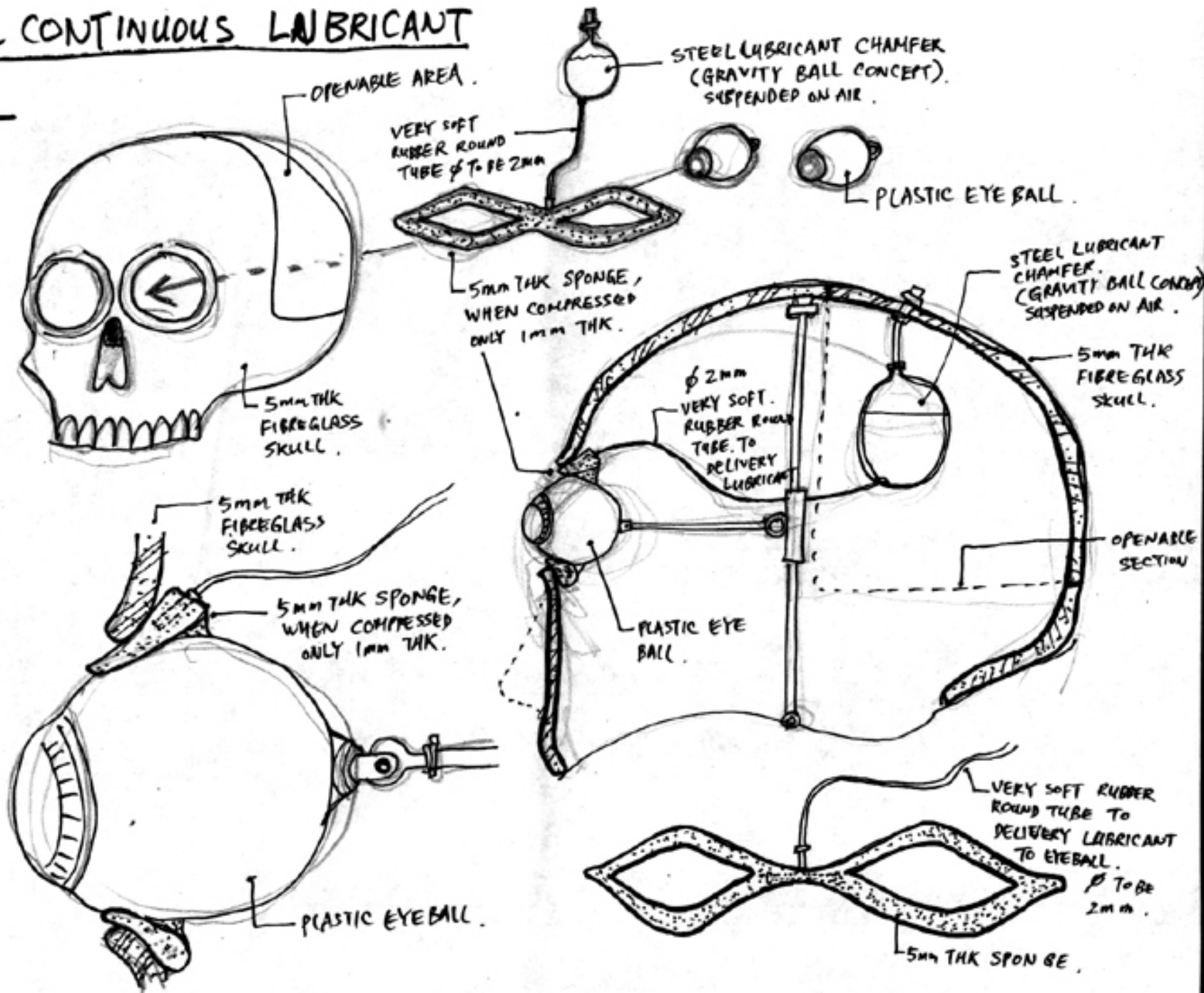
No smart control yet.



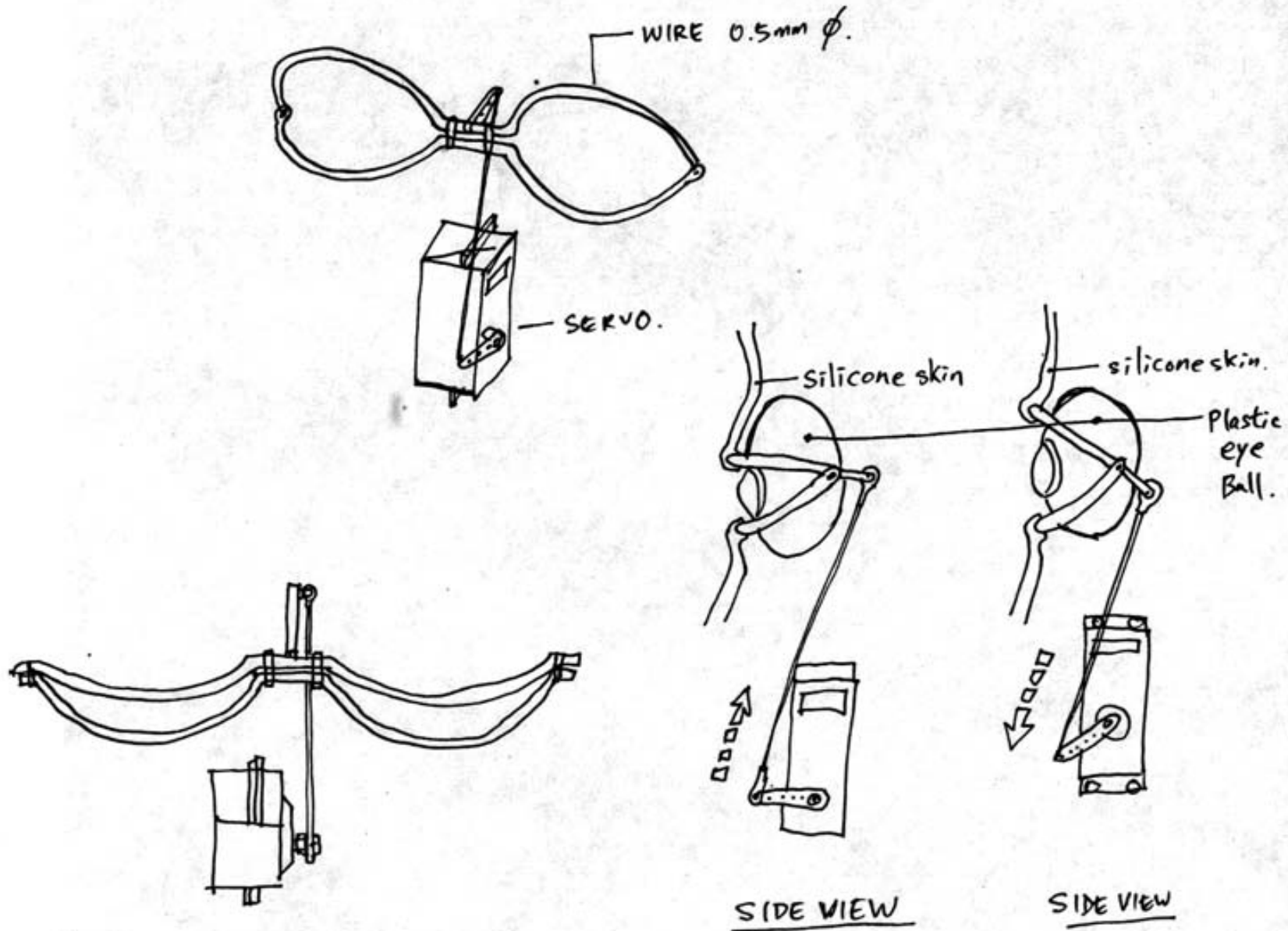


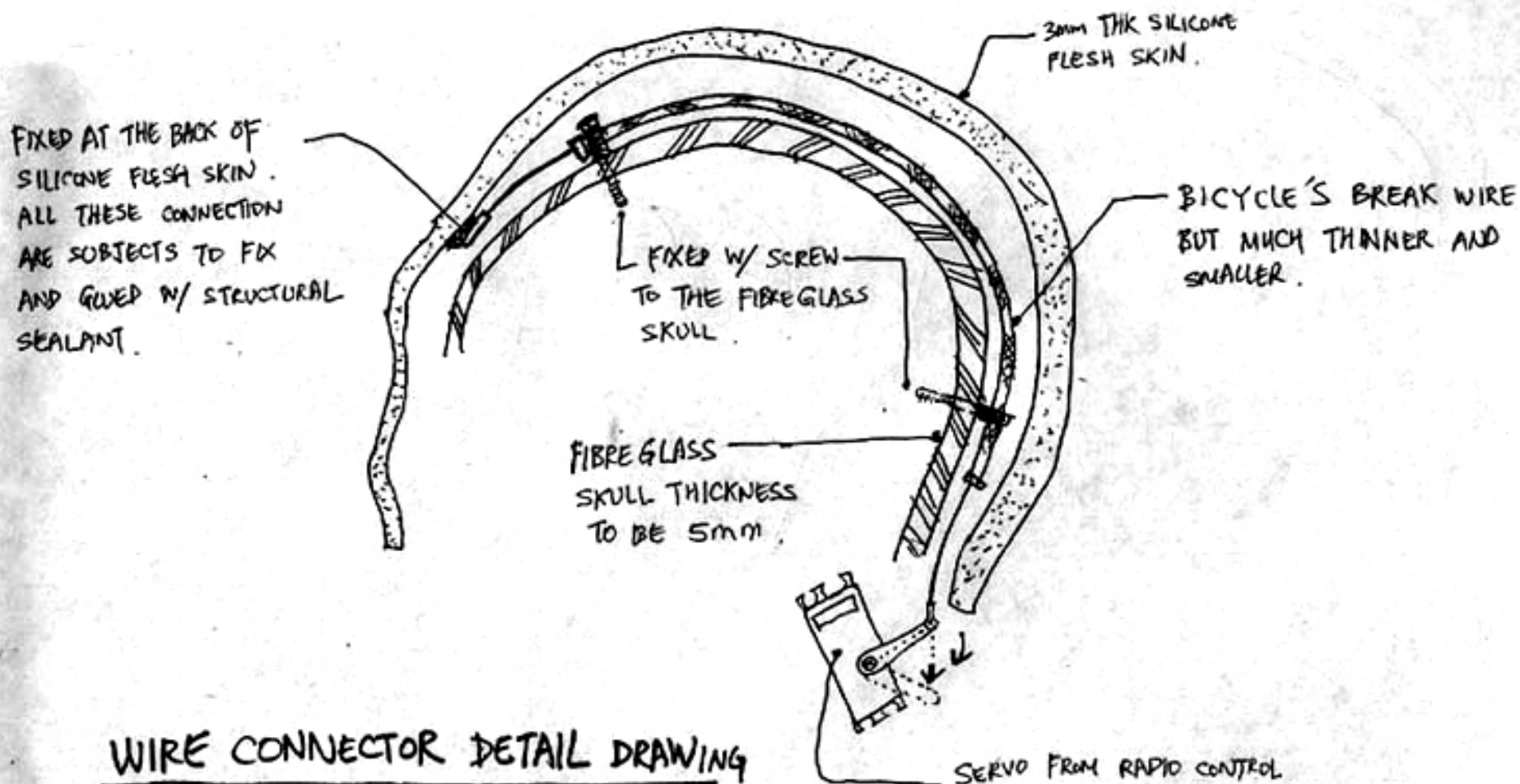


EYEBALL CONTINUOUS LUBRICANT IDEA



Eye and lips





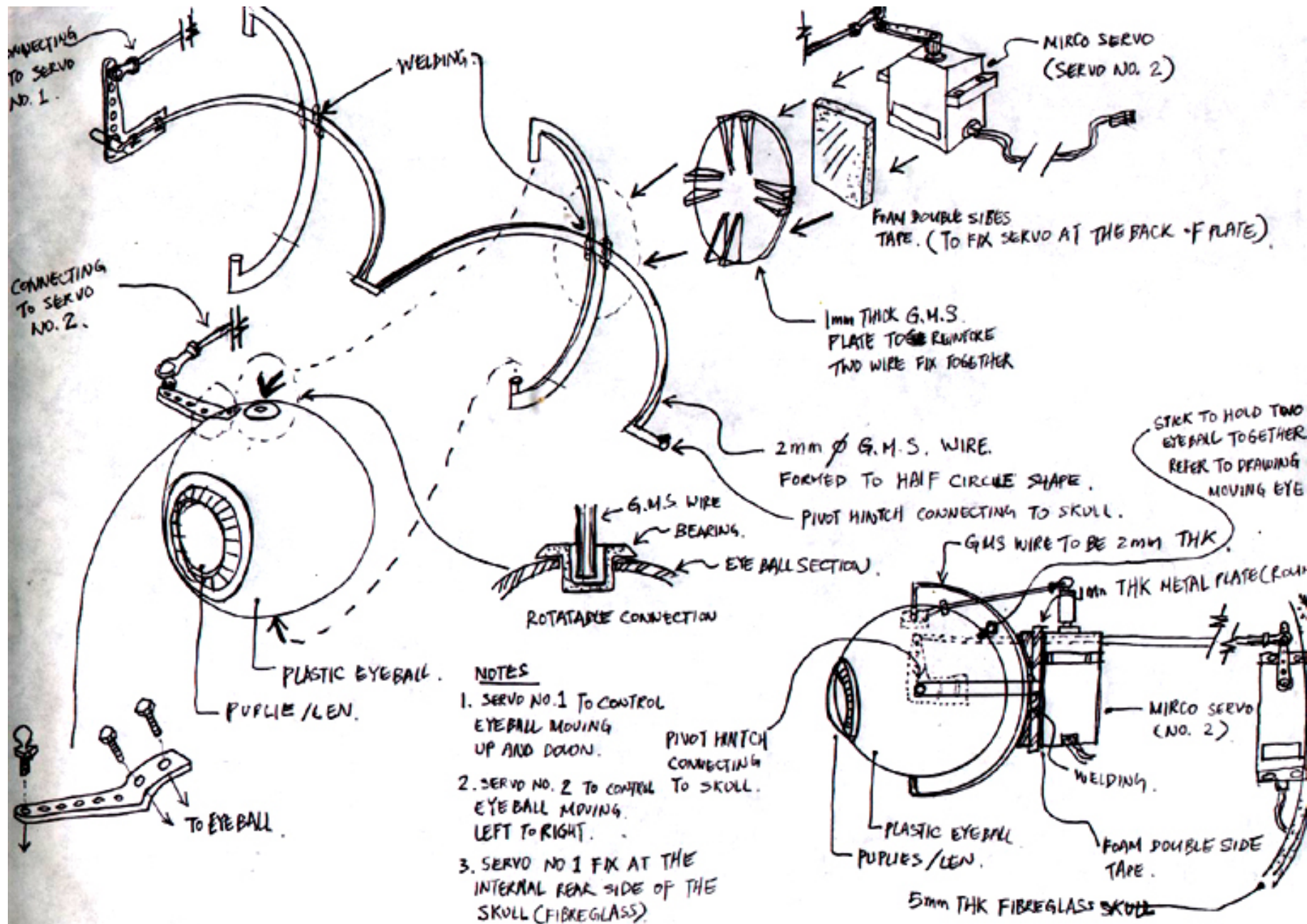
WIRE CONNECTOR DETAIL DRAWING

REFER TO DWG (FACIAL-01)

SCALE = NOT TO SCALE.

SERVO FROM RADIO CONTROL
CAR. GIZE TO BE (1" X 1 1/2" X 1/2")
(MICRO SERVO)

Eyeball detail



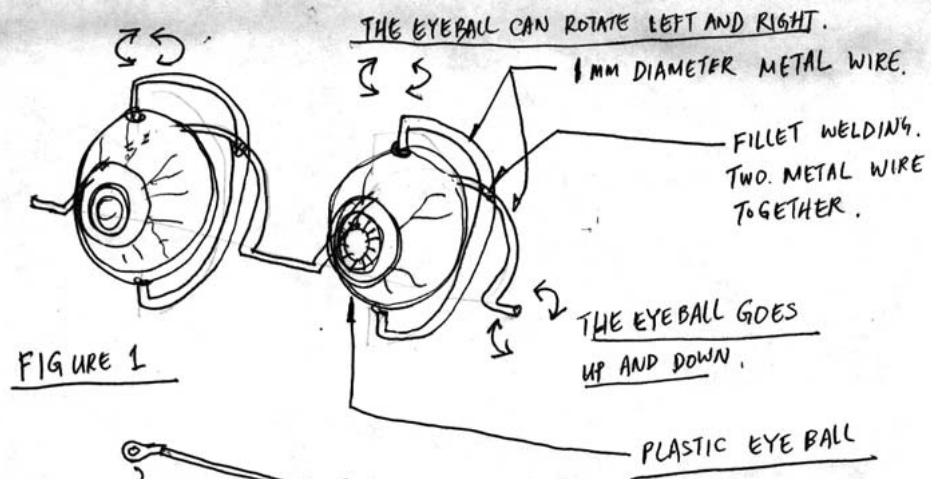


FIGURE 1

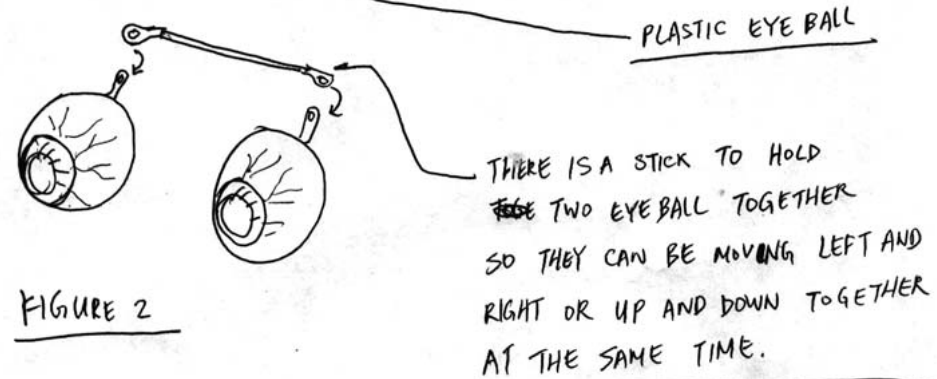
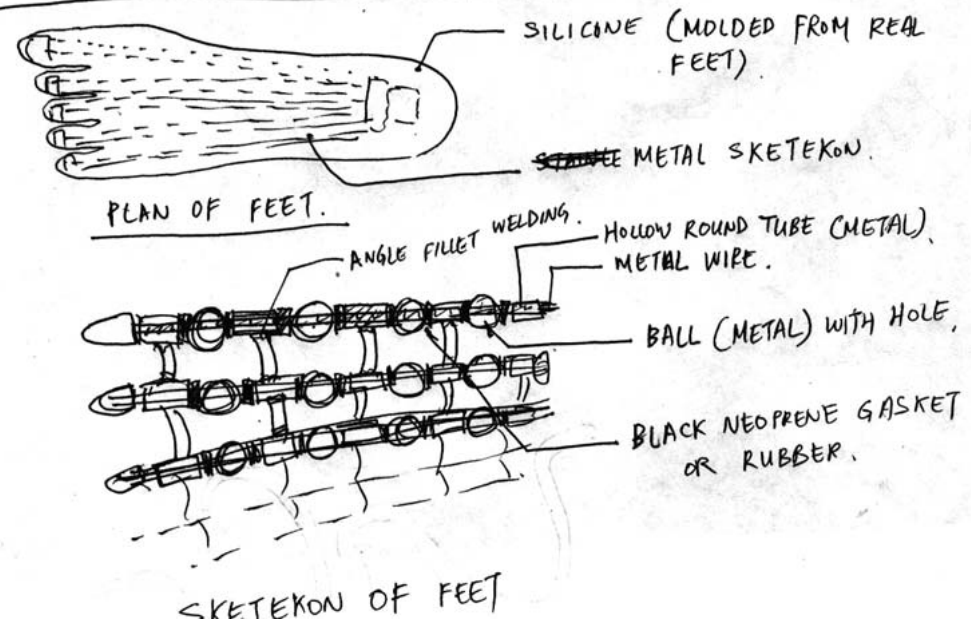
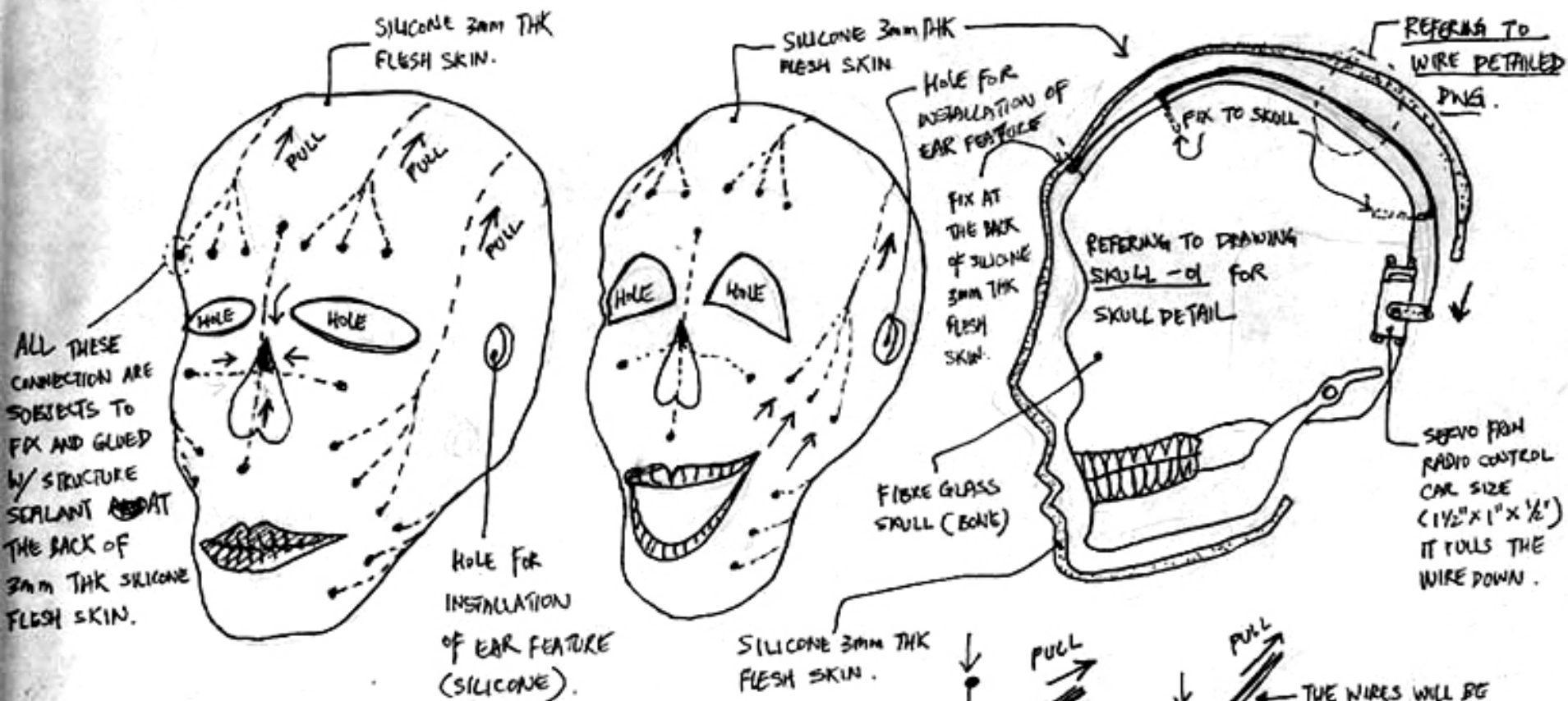


FIGURE 2

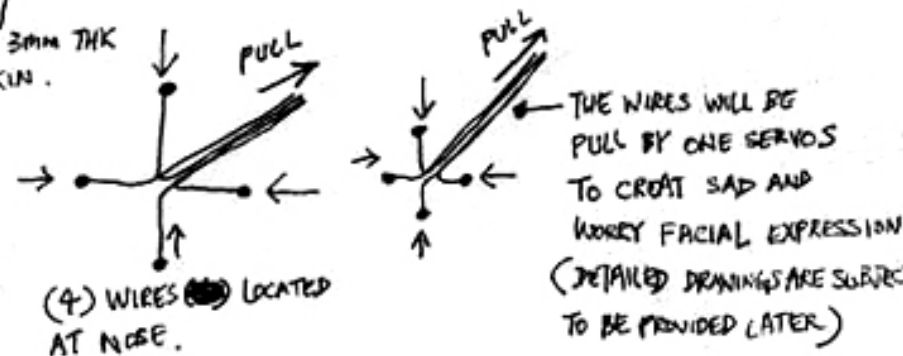




DETAIL DRAWING FOR FACIAL EXPRESS PRELIMINARY SKETCH AND CONCEPTAL DESIGN

SCALE = NOT TO SCALE.

DETAIL REFER TO DWG (SKULL-01)
(MOVING EYEBALL) THICKNESS OF MATERIAL
NEEDED TO BE TESTED UNDER WORK SHOP.



FACIAL-01. (DRAWING NO.)

7-Doll2001

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T-01



T-02



T-03



T-04



T-05



T-06



T-07



T-08



T-09



T-10



T-11



T-12



T-13



T-14



T-15



T-16



T-17



T-18



T-19

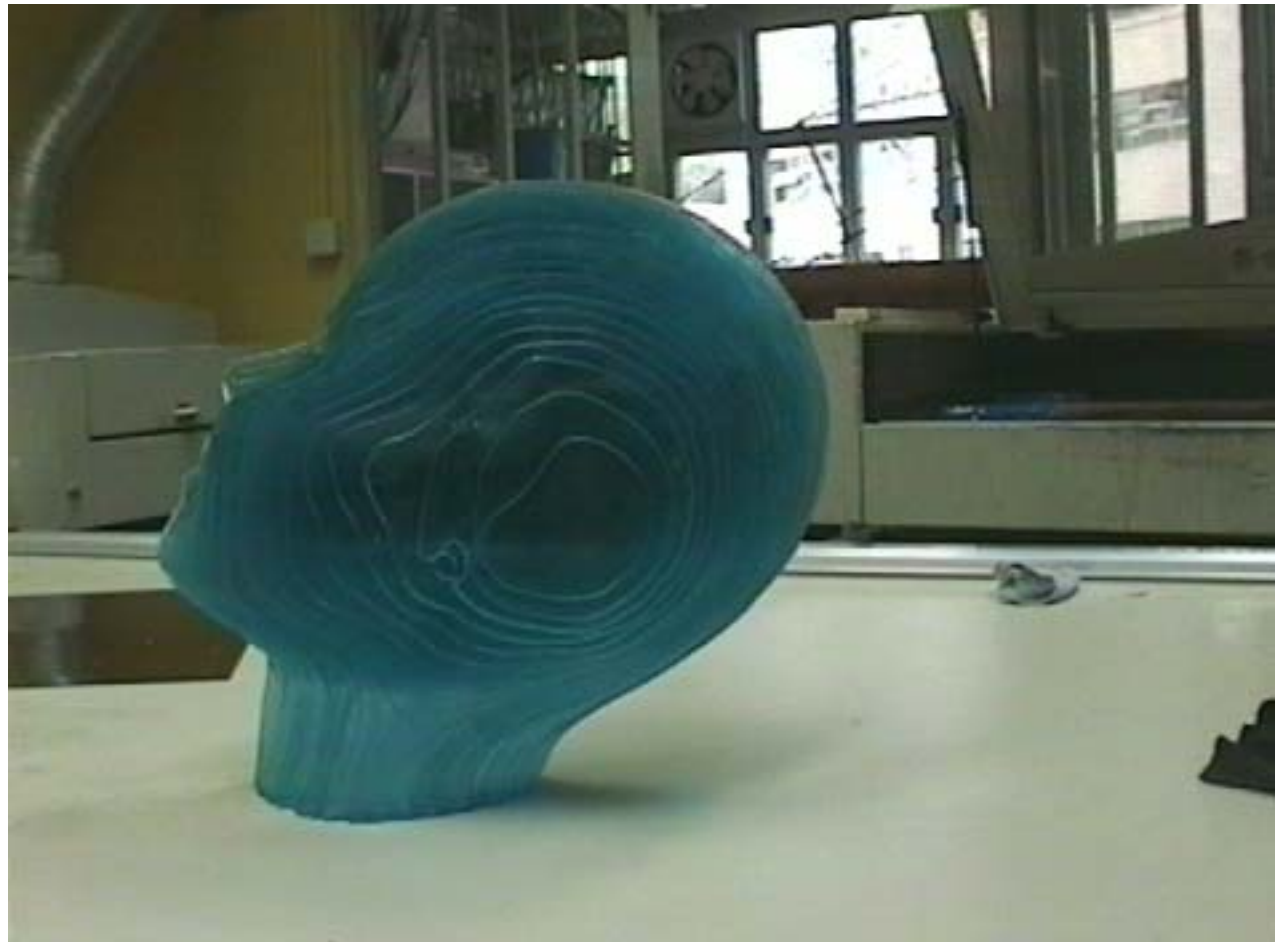


T-20

Head Type

**The following slides will
show the head
development sequence**

This head has been cut out by a
Laser Cutter from clear acrylic
material



Another view of the head



We have two Laser Cutters - No.1
and No.2



The cutters are model "LasLite 1000"
and have a work area of 30" x 40"



We have 9 computer systems and large plotters too....



Another View of the Head with Mirror...





A mirror helps to see the other side

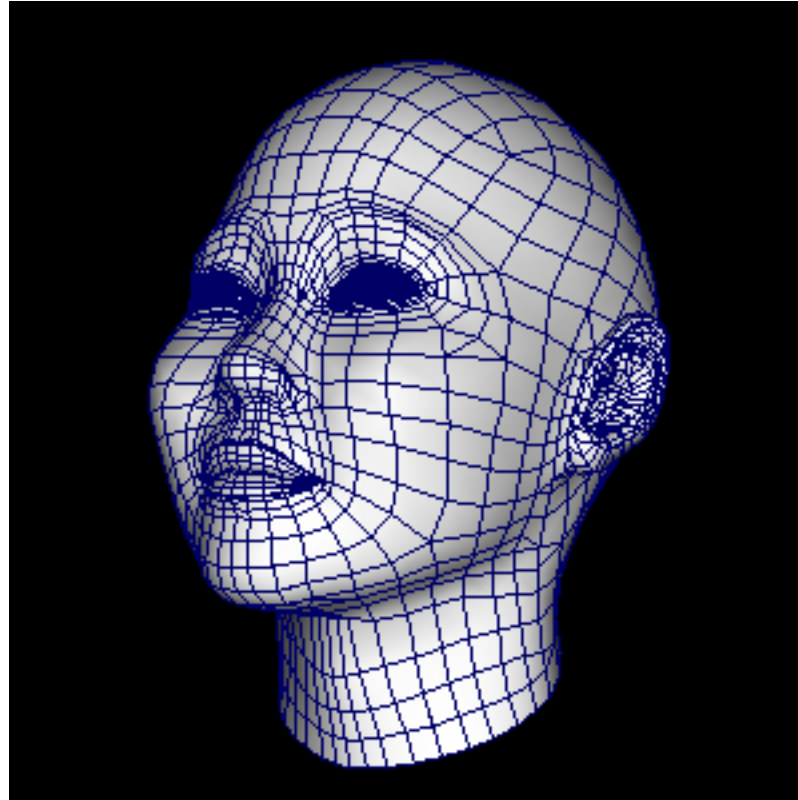


Head in white

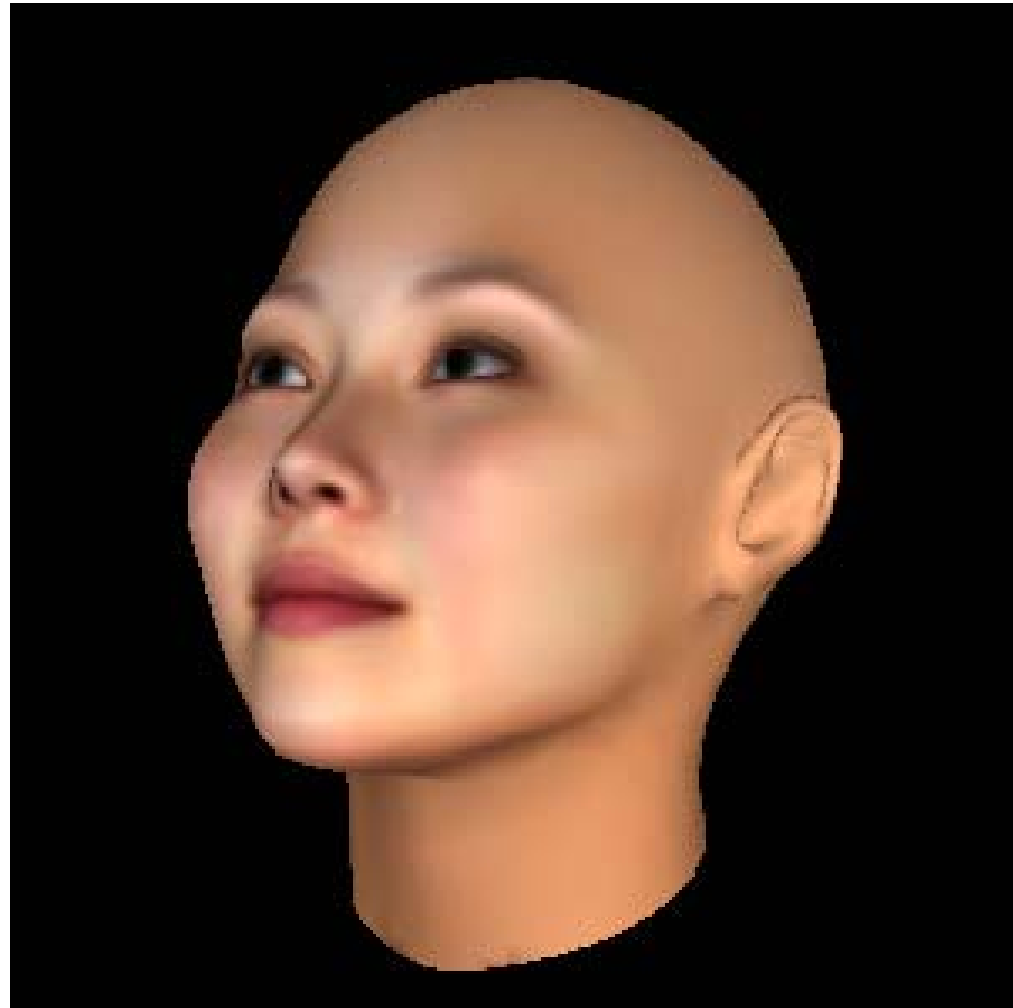




Here you see a very Early Stage of
the head



Comparing the Head with the Computer
Rendered Image with Mapping



The next thing is to put the Polyester Auto-Body Putty on its surface (pic-1)



Next the surface is sanded with sandpaper



Emily is the real model for this project. Her head was not made from a life cast.

The data and dimensions were recorder from her skull carefully. David Ng wanted to see how close a likeness I could make from computer software to a reproduction of her.

The first master of the head mold is almost finished.?

As you can see it will be very detailed.

Details such as skin texture, eyelids, lips, nose, ears will all be included.



1-DOEE-2001

Another view of the head



Front view of
the head.



I-DOLL-2001

The skull is also almost finished, Wires, cables, and anchors on the surface of the skull will be installed. The skull is 10mm smaller than the skin over the whole surface. The silicone skin is planned to be 5mm thick. There will be 5mm of space for installing components such as wires and cables. The left over space will be filled with spongy material. They will also put some blue, green and red veins and blood vessels on the surface of the skull. The silicone is semi-translucent so you will see the veins and blood vessels from the outside. It will look very realistic and detailed. David spent a lot of time figuring out the correct dimensions of the skull required by the custom made head above. It will fit the skin exactly.



I-DOLL-2001

Each tooth is life sized and cut by the laser cutter.
The defects of the teeth will be also reproduced.
However, the upper and lower jaw are 16mm wider than life.
This is because he will install a servo under her tongue inside the jaw.
It was short by 16mm, so he modified the jaw to fit the design.
From out side, it still looks the same.
The silicone will get thinner in that area.



A company has already made an artificial lung for this project, which will be hidden inside the stand. The stand will be 12" high.

It will contain some equipments and a transformer.

Making a head was much harder than expected. The head will have skin texture and veins and blood vessels.



The head will be able to make most of the human expressions, including crying and laughing. However, the frown expression did not come out the way that expected. Heating coils on the surface of the skull are installed. The head will be kept at 98 degrees - usual body temperature. A speed control for breathing was made which will perform the inhale and exhale actions.



The back side of the skull can be opened for maintenance and repair.

Many servos, motors, coils, and circuit boards are installed inside the skull



David's company has two table saws to cut hard materials such as wood, aluminum, acrylic plastic....



On the advanced and upgraded version of this head, there will be sensors inside her ears.

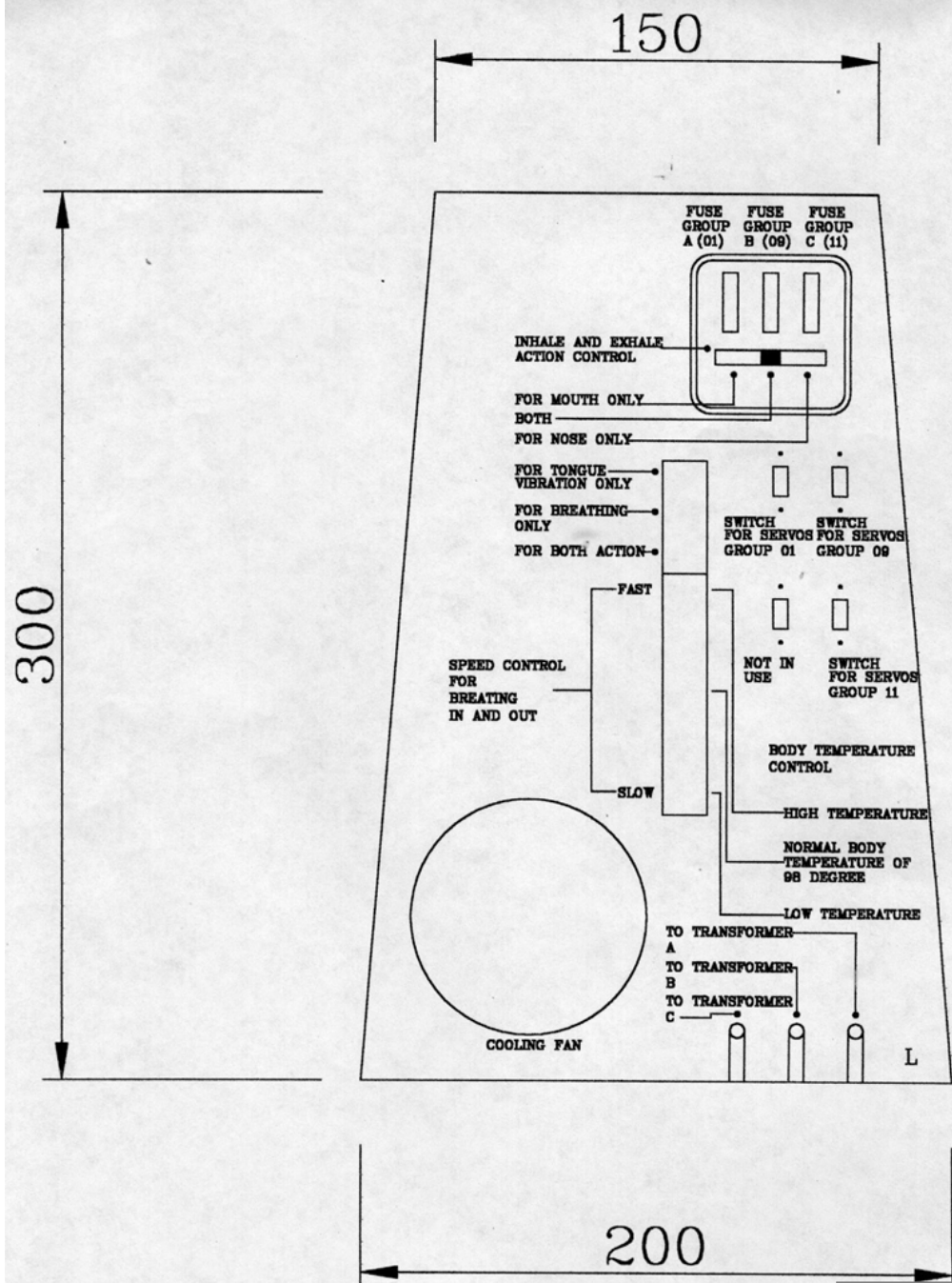
The head can be ordered with a moveable neck which will provide 3D motion - i.e. turning the whole head in all 3 dimensions.

The cost of neck has not been determined yet.









EYEBALLS
UP AND DOWN

EYEBALLS
LEFT & RIGHT

EYELIDS
UP AND DOWN

MOUTH
OPEN & CLOSE

EYEBROWS
UP OR FROWN

FACES
HAPPY & SAD

Transmitter T8001

(8 channels, AM transmitter)
Transmitting frequency:
27,28,40,41,70 or 75 MHz
Modulation method: AM

Power requirements:

Battery power source
Current drain: 200mA
27,28,40,41,70 or 75 MHz

Serve S8002

(standard servo)

Power requirements:
4.5V or 5V (common with receiver)
Current drain: 2mA (at 5V/10Hz)

Output torque: 2.5kg-cm (at 4.5V)

Operating speed: 0.55sec/60 degrees (at 4.5V)
Size: 40.4x 18.5 x 20mm
Weight: 27.5g

Receiver R8001

(8 channels, AM receiver)

Receiving frequency:
27,28,40,41,70 or 75 MHz
Power requirements: 4.5 - 5.5V

Current drain: 50mA (at 4.5V/10Hz signal)

Size: 47.5 x 25.5 x 17.5mm
Weight: 16.5g

1-DOLL 2001

All the internal parts are now completed.



As you can see, it looks quite complex inside the skull now. However, there is still 30% of the skull space left for the clients to install their own components, such as microphones, speakers, or other items.





Another view of the back of skull.....



This is the front view of the skull.
The eyeballs are custom made with PVC.
The iris can be opened and closed with threads.
Clients may install their color micro video cameras inside the eyeballs.....

Cooling air will
blow from
inside of the
stand and will
be forced
upward to
Emily's head to
keep it cool.



Since Emily has
very long hair,
her platform
must be at least
16" high to
prevent her hair
from touching
the ground.



You can see two hoses are connected to her nose.

And a single hose is connected to her mouth.

When one presses the switch for breathing through her nose only, the air channel to her mouth will be blocked.

When one presses the switch for breathing through the mouth only, the air will be blocked to the nose.

If one presses both action buttons, then both the nose and mouth will be breathing at the same time.

They are all connected to a speed control which controls the speed of inhaling and exhaling.



On the bottom side, you can see there is a motor located under the artificial lung.

That motor is also connected to the speed control.



The front view of the R/C control panelbox.

You can either use 24 AA size batteries or direct current from an external power supply.



The back view of the R/C control panel box.
For more details, information or specifications, please refer to
PhotoGallery number 3.



Head Development Sequence

- 1. When we receive photos from a client, we use computer software to generate images of the head. The program will then render the image of the head. We then send the client the images and animations for his/her approval.
- 2. After we receive your money order, we begin the fabrication process. Of course you will receive an email confirmation of your order.
- 3. Once the client is satisfied with the images of the head, we send the data files to our laser cutters. The head will be cut very accurately.
- 4. Next we make the mold and cast the form from silicone material. We use polyurethane plastic for the skull.
- Option A: Without automation functions USD \$2000.
- Option B With automation functions USD \$3000.
- The automated functions includes:
 - a) Open and close eyelids.
 - b) Move the eyes left and right.
 - c) Move the eyes up and down.
 - d) Make a smile or return to normal.
 - e) Open and close the jaw.
 -
 -

Frequently Asked Questions and Answers of David Ng

- **1) What is your website URL?**
- **We are now writing a new website but it is not completed. The URL is (<http://robotic-head-by-david.com>). We need to install many more photos, explain the type equipments we have, and the samples we have created. It will contain about 40 pages of photos and text, and another 42 pages of my free hand drawings showing most of my ideas. All ideas are original and created by me. We need approximately 8 weeks to completed this documentation.**
- **2) How much volume is available inside your android head?**
- **We have attached a 3DS file containing 3d information, as well as volume and area data.**

- **3) What are your 5 channels?**
- **Channel 1 = eye up and down, Channel 2 = eye left to right, Channel 3 = eyelid open and close, Channel 4 = smile and back to neutral, Channel 5 = Jaw open and close, Channel 6 = Happy and Sad. Please refer to my PhotoGallery No.3 for more information, specifications and details**
-
- **4) Can I get more face muscles?**
- **We do not use face muscles. We use cables, wires, and an anchor attached at the back of the silicone face. Please see detail drawing and photos taken from our workshop for an explanation. We use 4 cables, 2 cables attached to each side of face to create a smile**
-
- **5) If so, at what price each?**
- **Not available at this moment. We are not confident enough to make all facial expressions at this time. Crying faces, sad looks, surprised (astonishing) expressions, etc. need a lot of experimenting and practice.**
-
- **6) I need computer control rather than radio control. Is a bluetooth interface possible?**
- **At our level, we are not able to build a computer control, but we are able to build a radio R/C Type control system. Maybe you can ask John, he will do this part for you. For more information, please refer to my PhotoGallery No.3.**

- **7) Could I send you eyes to put into the android's head? I have eyes and video cameras to go inside them which I want in the head.**
- **Of course, Yes! For more informations, please refer to my PhotoGallery No.4.**
-
- **8) How do I specify the size of the head?**
- **The eye separation on the head I have now is 2 5/8" center to center. Do you have any kind of design intended? Drawings such as workshop drawings, or blue prints would be helpful. Or maybe Autocad Drawings? If you have them, send them to us. We will follow your instructions to make our products precisely and accurately.**
-
- **9) What about skin color? I prefer that the silicone be tinted because I'm worried that paint on the surface will flake off and look terrible.**
- **My partner James is a toy maker, he is responsible for this area. The technique used to "paint" the skin tone involves a combination of intrinsic and extrinsic coloring. When we mix silicone we will pour the color pigment in there. So it will not be flake off and look terrible.**
-
- **10) Does the head come mounted on something, or un-mounted?**
- **The head will be mounted on a plastic platform. Like a stand. Please refer to my PhotoGallery No.4.**

- **11. Can we remove and put back the skin on the skull? How many times?**
- **Silicone is a material of oil , resin and rubber. It has 300% elongation ability. The neck will be opened up... then you insert the skull inside the head skin. It is like wearing a glove, the head skin is similar to a glove, and your hand would represent the skull. Do you see what I mean? After this you glue the eyelid wire to the skin. I do not how many times you can take it off, but we prefer only once to prevent damage.**
-
- **12.) What kind of glue do you use to affix the cables to the silicone?**
- **We use anchors that are embedded into the silicone skin before it gets cured and set. For more information see my cables and anchor fixing detail drawings.**
-
- **13.) We would like to create a "robotics laboratory" head project based on your head with our upgrades; speech, vision, hearing, faces muscles, and AI. Is this possible?**
- **Sounds good to me.**

- **14.) What would the cost per head be for 10 identical heads? I would like to order a head ASAP. But, I need more than one skin for it, because I expect that we will ruin at least one or two trying to get the face muscles attached properly. How much would extra skins cost? That is, one skull and several identical skins.**
- **Please realize that due to the material cost, labor, and rent of the factory, and moreover the cost of operating the laser cutter is very costly. I can only the maximum give you a 10% discount if you order 10 heads from us. It will be U.S.D. \$ 1800 each.**

- **15) I think you said you need three pictures? I would like to send you the pictures ASAP. How much money do you need for a deposit on the head? I would expect some feedback from you before you began construction. That is, I would like to see the computer animation and be able to suggest modifications.**
- **I divided the human head into 60 sections, for example the eyelids have one section. The nose has 5 sections. Each section is a Pitch Grid. The grid has 40 to 100 intersection points, (Vertex Points). By moving the Vertex points up and down, we are able to change a higher nose or bigger eye... etc. It is a extremely labor intensive work and time consuming. So we need 10 to 14 days to construct this wire mesh head. when the wire mesh is finished, I will send you many different views of the head, also an animation of the head turning around will be included. At that point you will tell me, "David, I want to have a higher nose, or I want to have a bigger ear...." All the changes are possible to make.**

- **We must do (All) the changes according to your comments to please you until you are 100% satisfied with the head image. It really does require a high level of computer operating skills. Your money, 1500 dollars per face, is already included this portion of service. Once we have your approval, we will send the data to our laser cutter. At this stage, everything is final and not changeable. Moreover it can tell you how she is going to look like after 5, 10 or 20 years. Or you may ask me how will she look when she is 60 years old. Age morphing is another control that we have, we also have race morphing controls. Moreover, we can stimulate when she smiles or frowns. You can see in detail how the muscles move when she is smiling. Your staff then can find out where the best locations are to place the wires and cables, where to place the anchors, etc.**

- **16) I'm surprised that the skin costs \$1500. Its just a little silicone with some pigment added. I can't afford 3 at that price. I don't have any accounts in Hong Kong.**
- **Can you buy a Money Order from a bank in U.S. then send it to us? We are not set up to accept credit cards at this moment.**
- **17) Half down and half on delivery?**
- **I am very sorry to tell you that deposit is not acceptable. All the doll makers at the US. are not accept deposit.**
- **18) It will take a week for my check to reach you and another week for it to clear. That's two weeks wasted. What about credit cards?**
- **Sorry, credit card is not available at this moment. If we really can not serve you at this moment, we hopefully can serve you again in the future.**

Future Development

- **1. In the near future, they will install an “electronic brain” in the head.**
- **2. They may use embedded controller chips to move the servos at random as though it were alive. It could use a pseudorandom pattern that would look convincing. The remote controller and sensor would have priority so if sensor were active, then the tongue would move.**
- **3. The problem is they are short of funds for this project. They are looking for a sponsor to help support our project. Or, if they receive enough orders, then they might have enough income to develop the android's body.**
- **4. They are also thinking of installing a MP3 device inside the chest. The Doll could then have a large vocabulary of 1000 sentences. They would be chosen by the processor and played through a speaker.**

Master Lee.

YFX Studios build an
[animatronic man](#).

He is called **Master Lee**.

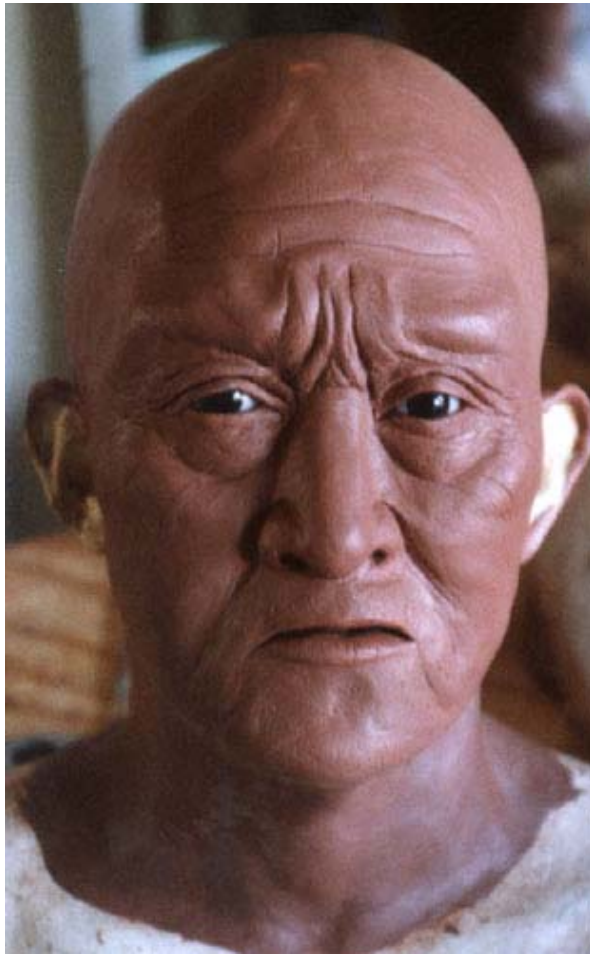
They have a 3MB movie
of the head talking with
facial expressions.

**And now he has a
body!**

He can move his hands
and arms.



Sculpture of head



Skin view



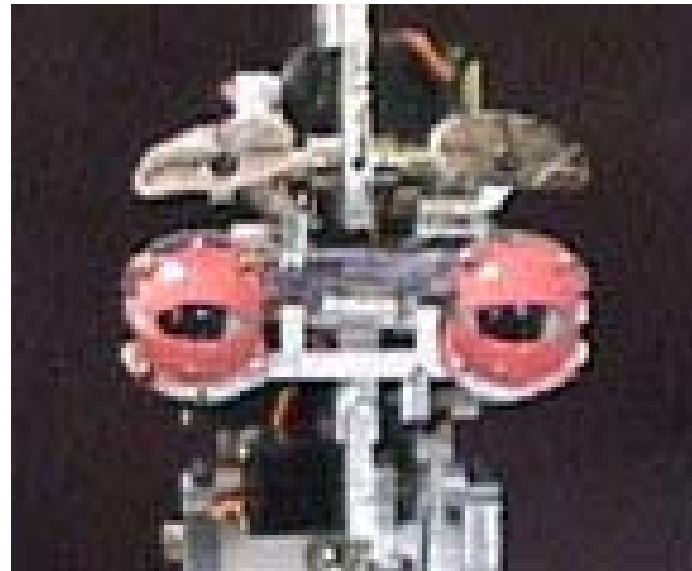
Master Lee.



Finished head



Interesting details of construction



Another head from YFX Studios

- Here is [another head project](#) which YFX Studios has done for the University of California at San Diego (UCSD).
- This head has 9 DOF.
- The project is being directed by Jochen Triesch.
- They are using the firefly digital cameras from [Point Grey Research in Vancouver, BC](#) for eyes



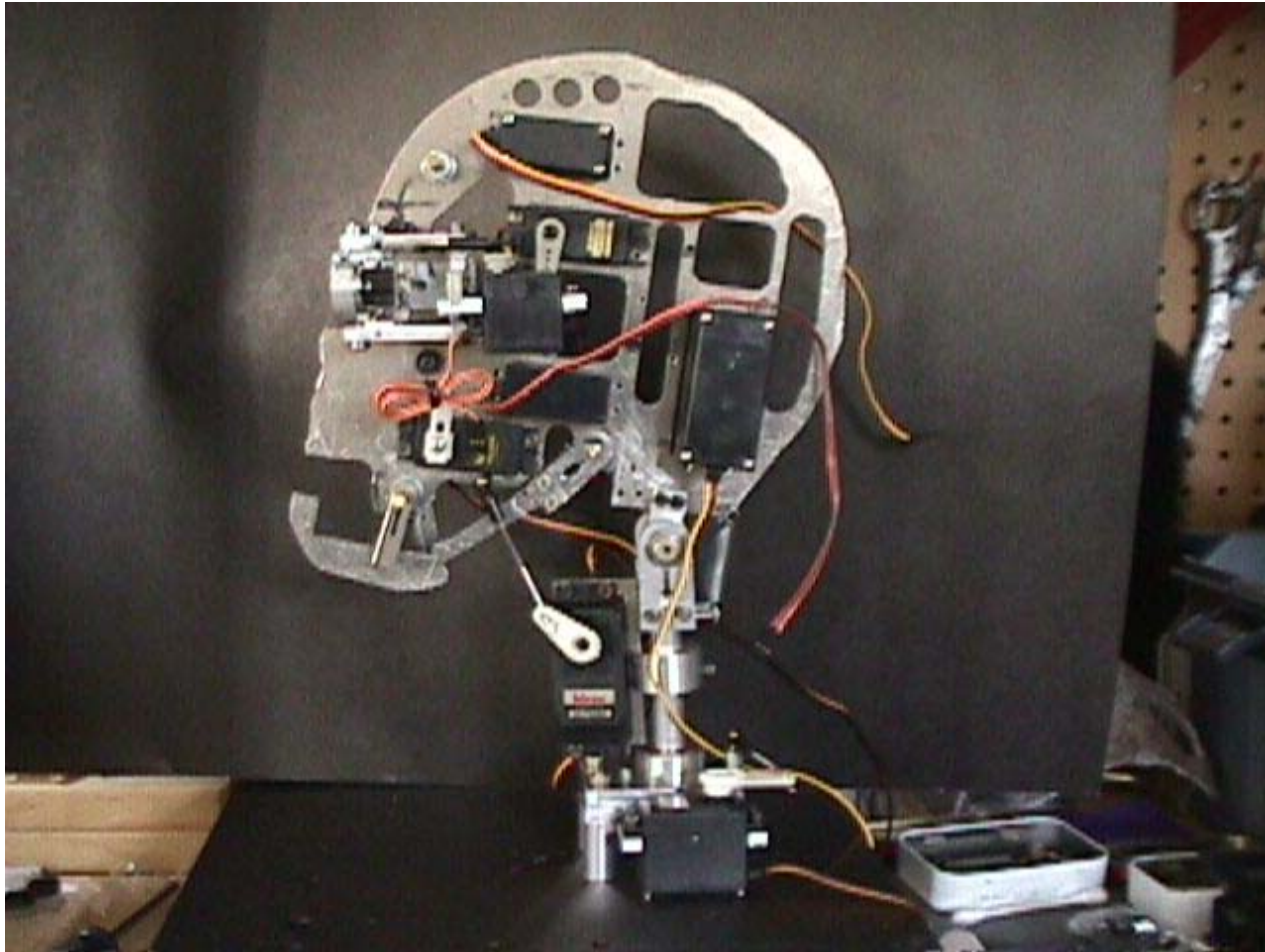
Anthropomorphic Robot Head

- **The Head**
- The head is an anthropomorphic head with 9 degrees of freedom.
- The neck can pan left and right and tilt up and down.
- The eyes can do individual pan and tilt movements.
- The jaw can open and close.
- The mouth can express smiling and frowning and the eyebrows can move up and down.
- All motors are standard off-the-shelf [servo motors](#) controlled over a serial interface via the [ASC 16 servo controller](#).

Skin of the head



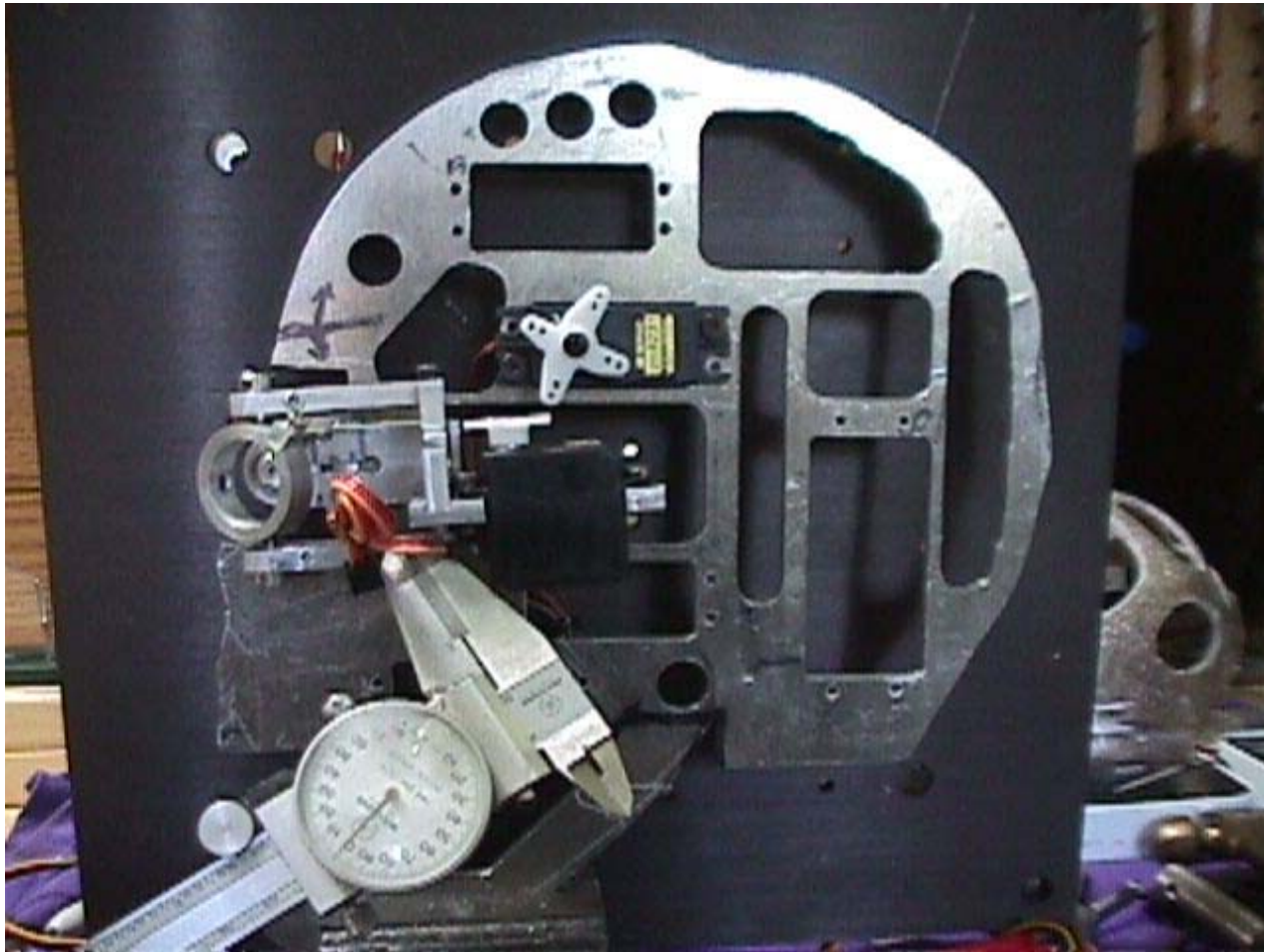
The head internals



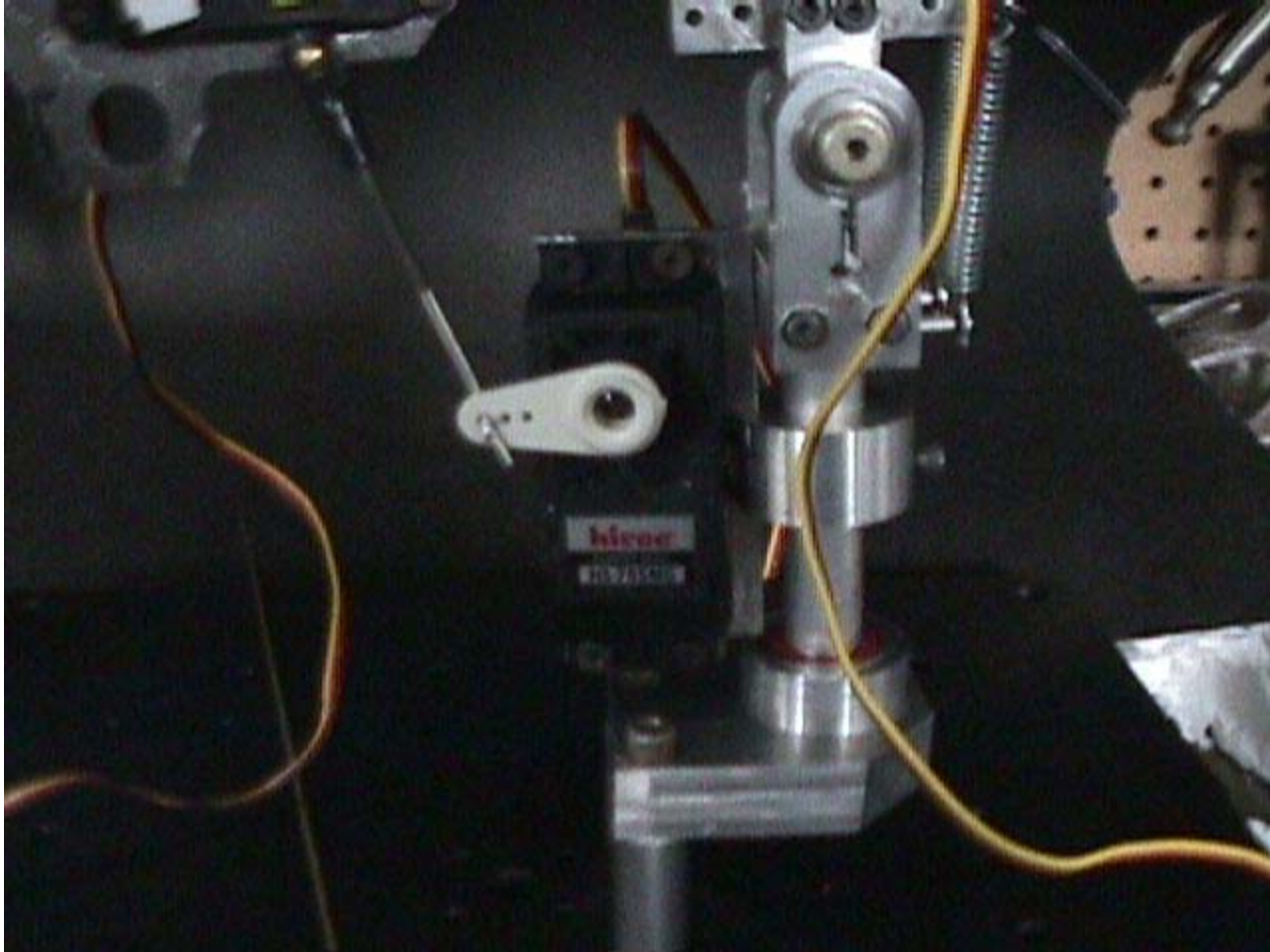
View of the head inside



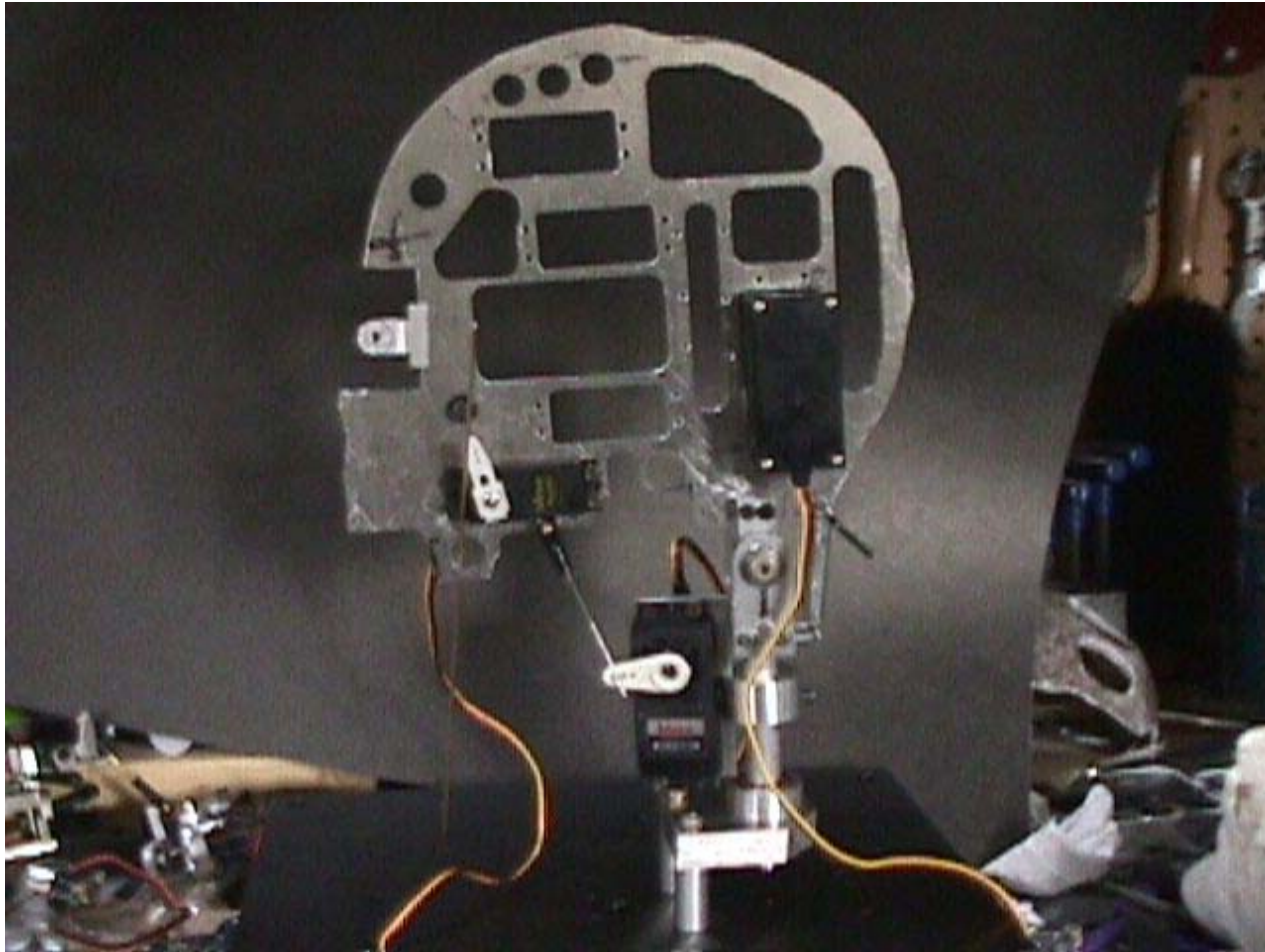
Another view of the keel plate



View of neck mechanism



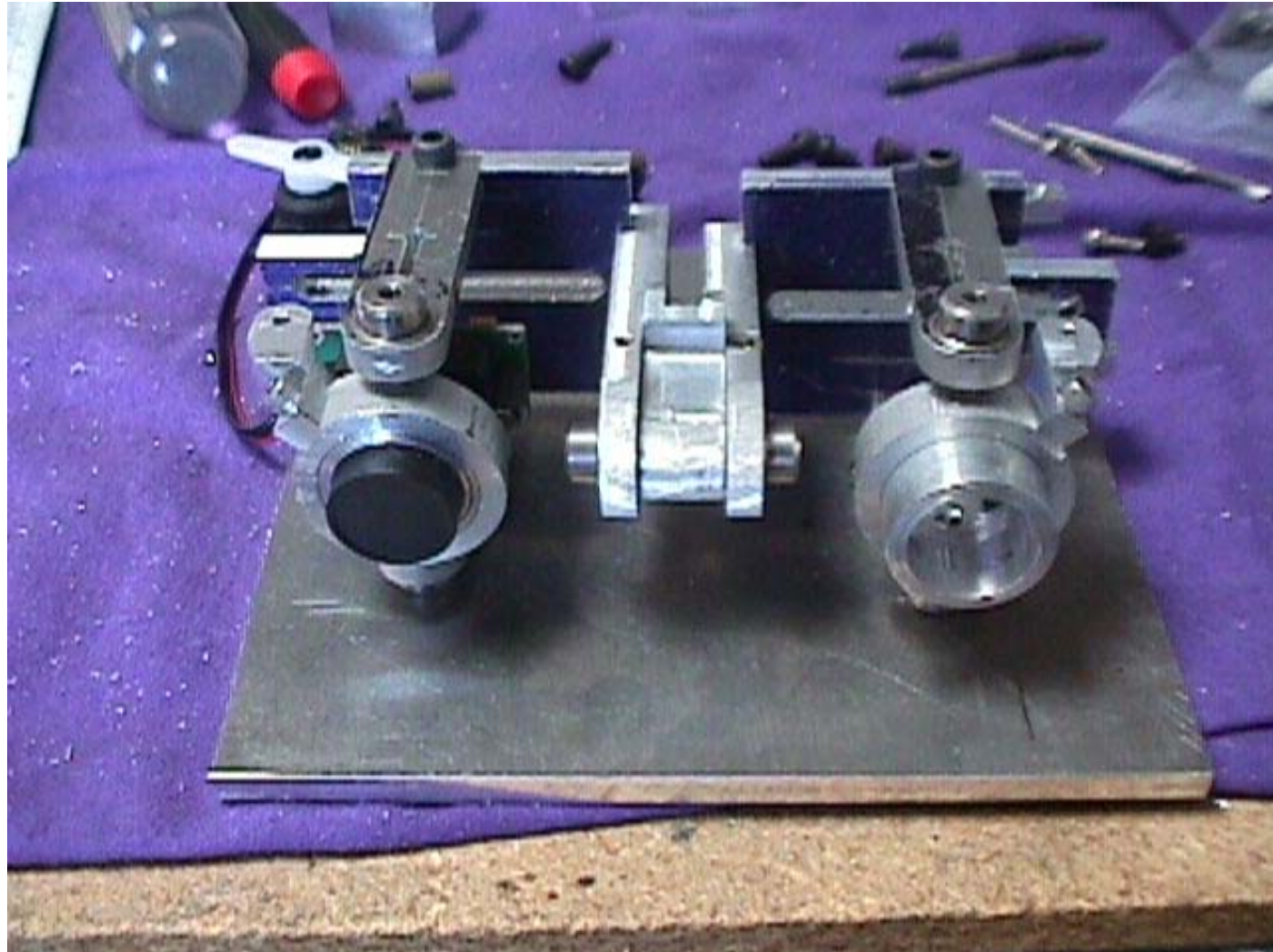
Another view of neck mechanism



The Eyes

- The project's aim is to model the eyes' degrees of freedom closely to the human example.
- While in the human eye there are three degrees of freedom (pan, tilt, and rotation around the line of sight) only the first two are modeled in this design.

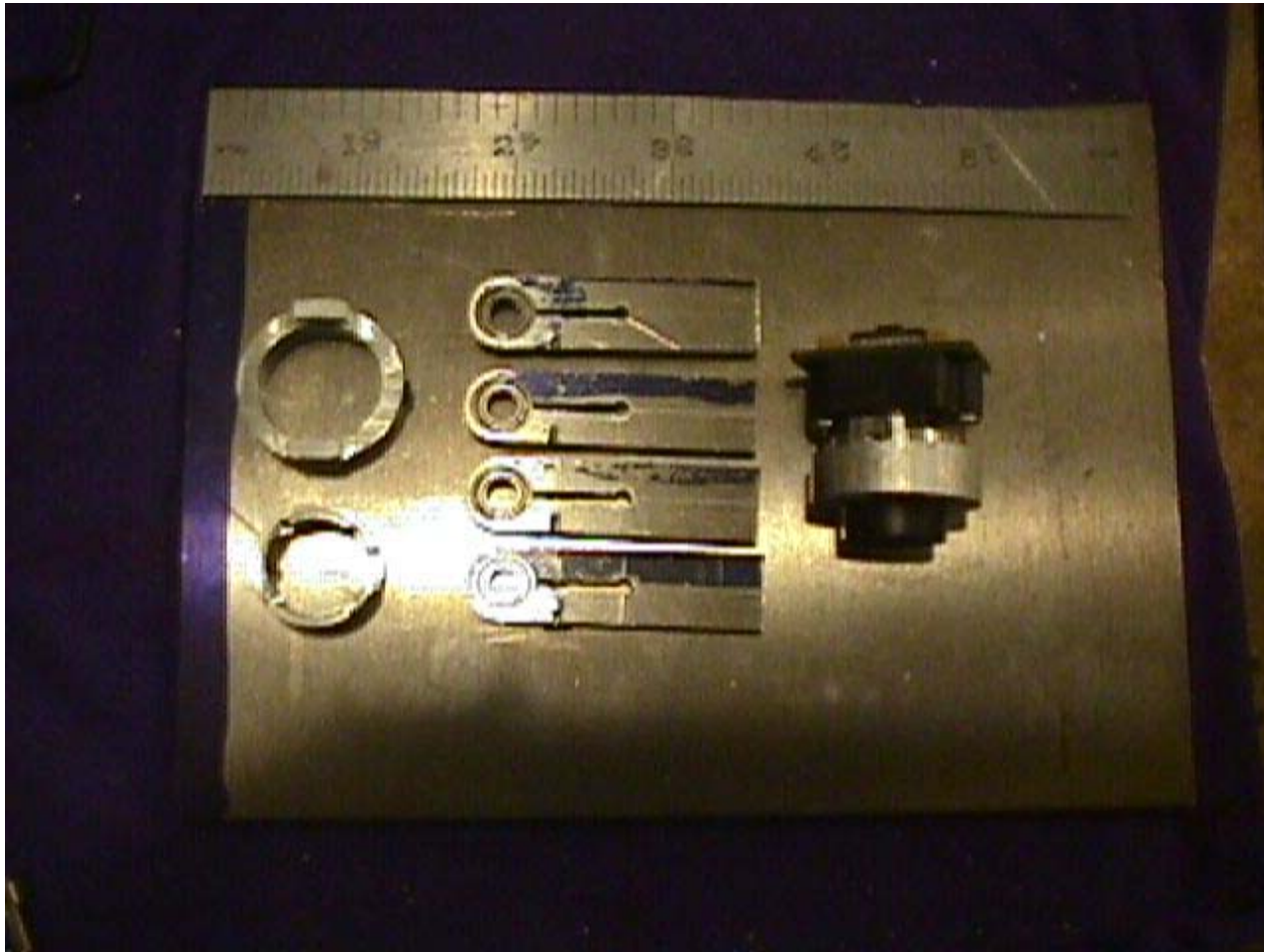
• Using high-end servo motors it is hoped to achieve rotation speeds of the eyes close to what humans can do, which is about 500 degrees per second.



Another view of eye mechanism



Some parts of the eye mechanism

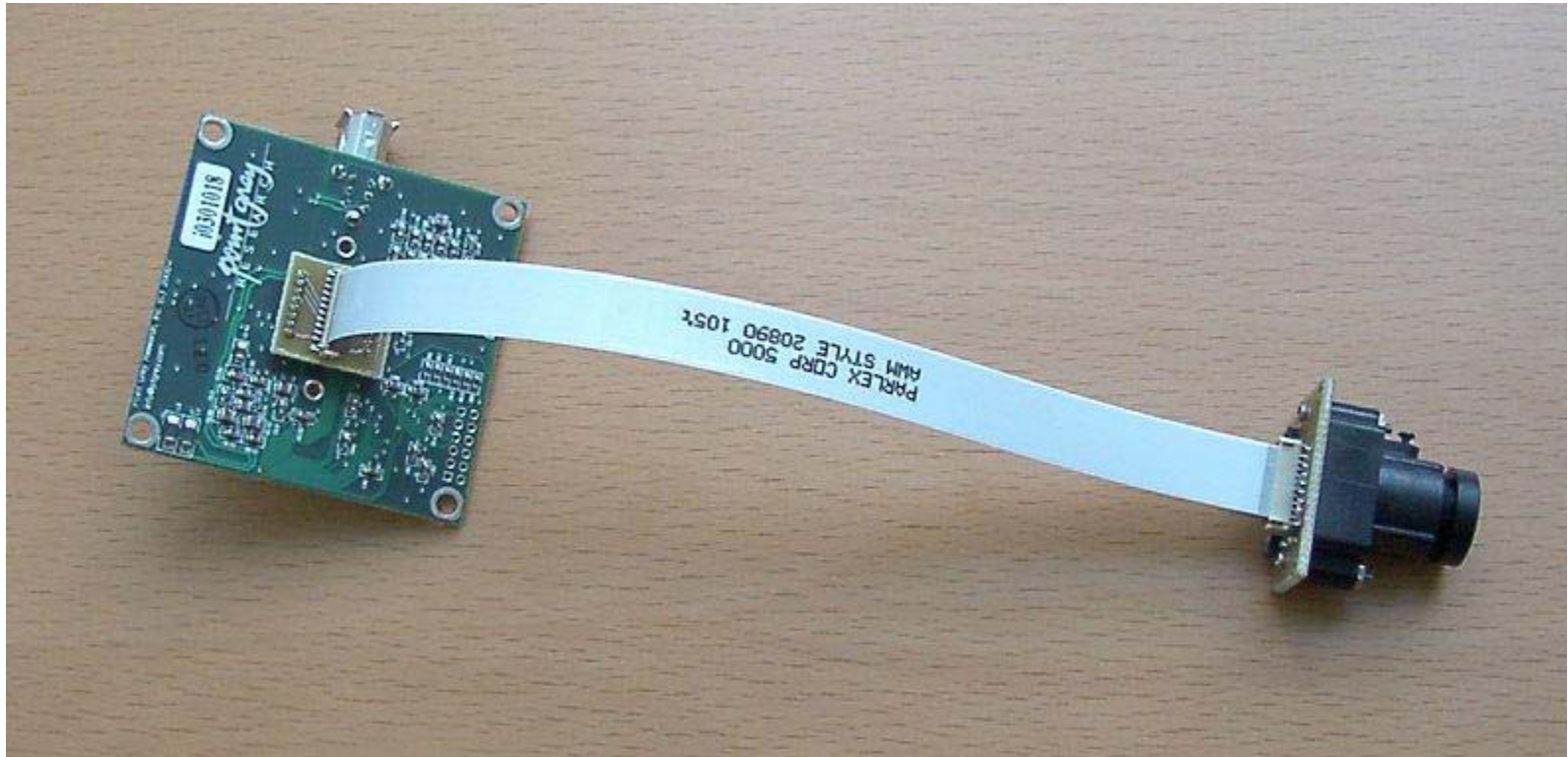




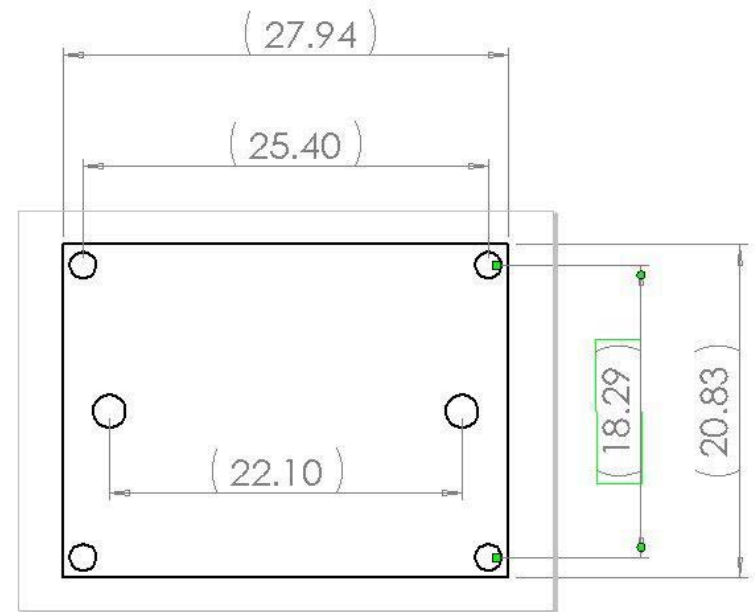
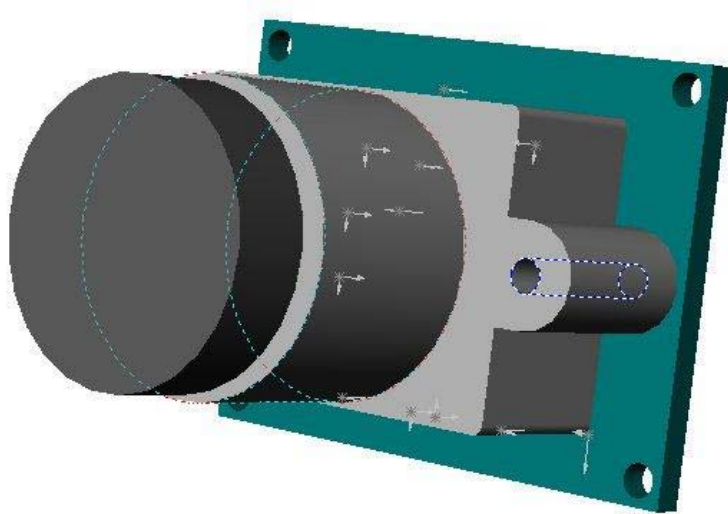
Cameras

- Into the robot's eyes we will fit two miniature cameras.
- The cameras are a pair of CCD (charge coupled device) cameras transmitting images over the IEEE1394 (FireWire, iLink) bus, a new serial bus capable of 400Mbit/s.
- They use the [FireFly](#) model by [Point Grey Research](#).
- They use the "remote head" option, where the lens and CCD chip are separated from the interface board.
- The successor of the FireFly, the [DragonFly](#), is a little more expensive and it is unclear whether it works under Linux.
- Its advantage is precise synchronization of multiple cameras on the same bus.

FireFly camera in remote head configuration.



Drawing of the remote head and sketch including its board dimensions.



EAP Head Project

- NASA now has an EAP (Electro-Active Polymer) [head project](#).
- This is a project funded by JPL in Pasadena, CA.
- The head was sculpted by [David Hanson](#) and animated by Giovanni Pioggia.

Lulabot by David Hanson of UTD

