

# Design and Development of a Personal Robot Doctor for Healthcare

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*The aim of this paper is to explain the design and development of a futuristic robot which can act as a personal doctor. This robot aims to act with the user interactively while it is connected to the cloud as well as human doctors. The robot can be used for real-time health monitoring in addition to provide basic health instructions to the user. The ultimate goal is to make the robot in a form of personal/social creature where everyone can benefit from it in home or office. This paper explains the early steps of development of doctor robot and in future we aim to improve this report in design, architecture, interaction and functionality aspects.*

## I. INTRODUCTION

In this paper, a doctor robot is developed to have the ability to provide a way for user and doctor to interact, and then user can have a remote date with doctor. Doctor robot will be equipped with a smart pad, and other kinds of sensors, also medical tools [1]. Doctor robot will also help user to do some simple body check including diagnosis and life supervision [2]. The robot needs to have cognition in order to act smart during interaction with the user [3]. This robot can be useful for various healthcare applications [4].

### Diagnosis system:

The diagnosis system can be divided into two parts, one is instant diagnosis, and the other is information diagnosis. The introduction is as follow.

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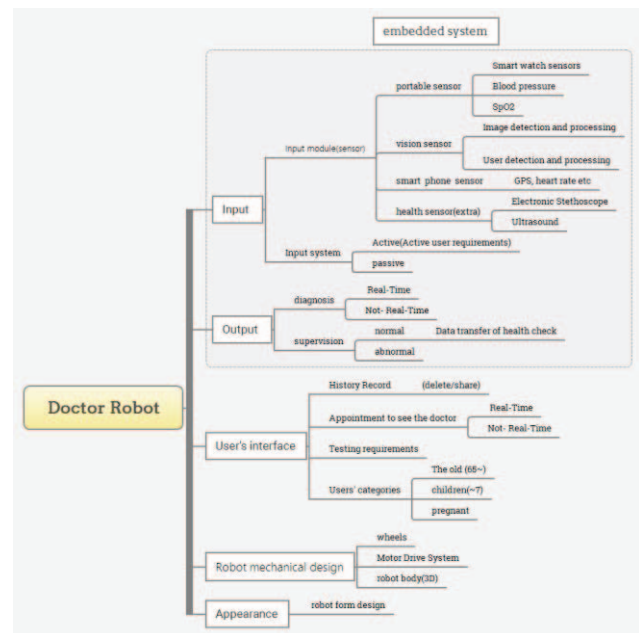


Figure .1 The system architecture of the doctor robot

### Instant diagnosis:

Instant diagnosis is designed for people living in remote district and physical-disable people. In this mod, doctor will remote control Doctor robot to check user's body through the internet. Signals (like: sounds, video) from the sensor will be sent in stream. For example: doctor can remote control Doctor robot to use electronic stethoscope, or use camera to check if the wound is inflamed or not. Controlled by a doctor, Doctor robot will be less error and become more humanistic [5].

### Information diagnosis:

Information diagnosis is used when doctor is busy. User can set the part which is going to be detected in advance. Doctor robot will use medical tools to detect the part and after processing the signals by microprocessor then save it. Through the internet, Doctor robot can send the data to hospital's cloud, and the data will be regard as user's medical record. At the same time, Doctor robot will send the medical record to doctor and let doctor analyze the patient's condition. After analyzing it the doctor will send it back to Doctor robot [6].

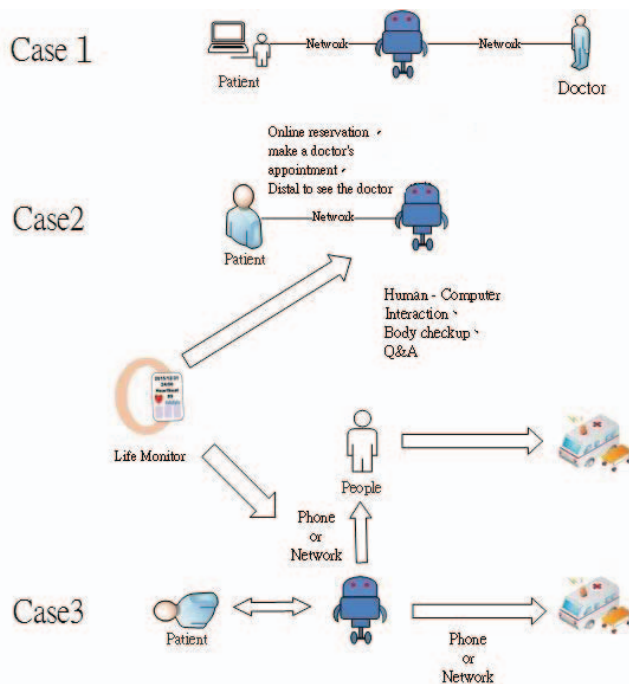


Figure 2. Several operation modes of the doctor robot

#### Supervision:

The pulse, breath, blood pressure, body temperature are called vital signs and these can let people determine if the life is safe or not. Doctor robot will calculate the weight of sum of pulse, breath, blood pressure, body temperature. If the weight of sum is over the standard, Doctor robot will determine the user is not safe and system will automatically turn into urgent mode [7]. Doctor robot will first play the call signal to remind the user if the portable device is not dressed well or not. After few seconds, if the call signal is not cancelled [8], Doctor robot will automatically send distress message to hospital which is nearby and call the ambulance [9].

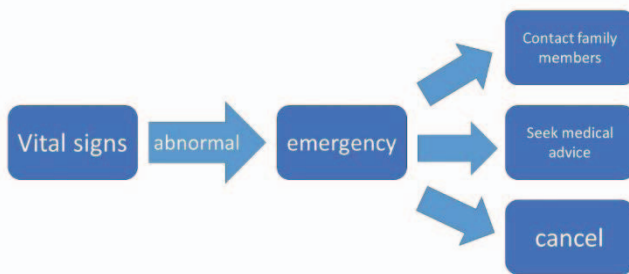


Figure 3. Life Monitor

When user have Critical situation about the life, the doctor robot will Send an emergency message to user's family, if unable to contact their families, the doctor robot will Send an emergency message to hospital and requirements taken to hospital [10].

## II. BACKGROUND

For the past few years, the population structure in Taiwan shows not only declining birth rate but also increasing aged population. And there are insufficient quantity on doctors following with the lack of medical resources. A crisis is a chance. The appearance of the doctor robot might be the solution to the collapse of the medical system. First, doctor's role will be changed. The robot will make doctors be a design engineer or a controller more than just a doctor [11, 12]. They will no longer need to spend plenty of time on clinical treatment. The doctors can not only ease labor but also focus on medical research and invention. Internationally, many robots or medical systems are developed for different medical purposes [13]. For example, because of geographical location or cultural factors, medical personnel could not reach and the patient couldn't be move to the medical center. In this case, RP-VITA was born. But the present medical robots are huge and expensive to build. Their functions are far superior to normal patient need. It caused patient to travel far and wide to consult a doctor. They did not even want to seek medical advice. These cases are followed by either ailments deteriorating which usually turns into chronic diseases or incurable diseases and adds much more pressure to the medical system, or going to the hospital for diagnosing minor illnesses like having a slight cold which makes the waste of medical resources. If we can use existing techniques to develop the medical robot laying emphasis on its light body and lower cost to build. It will reform the situations that medical resources distribution unequally in remote districts and abusing medical resources at home. The Doctor Robot will let the user ease spending more time on seeing the doctor. Also, it is designed for making the waste of medical resources drop. And its target user groups are elders, children and expectant mothers. In order to respond to the problem of population ageing nowadays. For elder users and younger users, their physiological situation can be monitored anytime and anywhere by the Doctor Robot [14]. Their location also can be tracked to prevent being missing. In this plan, we hope to design a robot with kind appearance that can touch deep to human mind. No longer just being a block of iron [15]. When the user is ill and need to see the doctor, he/she can ease their mental pressure [16].

There are a lot of researches about medical robot. In the market, there is PR-VITA doing remote inquiry so patients living remote area are not restricted. Although this is a good invention, it face the problem that most medical robots have. The problem is building a robot costs too much, and even the rent also takes fifteen thousand NT dollars per month. In our research, one of the purpose is to make the cost down and let most family can afford this doctor robot.

## III. SYSTEM DESCRIPTION

We separate the system into image processing and control system. The webcam captures images and is transferred to the computer, the computer connects to the Arduino to

control the robot's arm and simulates a doctor performing auscultation [17].

#### 1. Image processing

First, I use the webcam (640x480) to quickly capture images and save as a JPG file to easily process the image[18].



Figure.4 Face detection of the user

2. To read the image, we use Matlab as a tool to process the image. We use face recognition to detect the tip of a person's head to the chin and create a box.

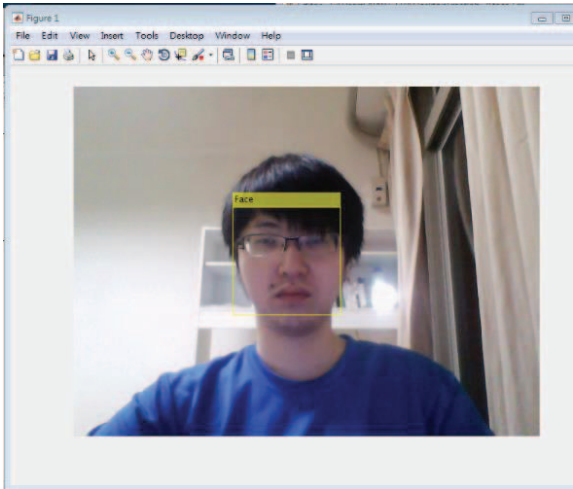


Figure .5 Completing face detection task

3. From the original image, the upper left corner is origin and the sides are its corresponding axis. The x-axis is 0 to 640 and the y-axis is 0 to 480. Then, we need to obtain the face recognition's origin (x1, y1) and its length known as v.

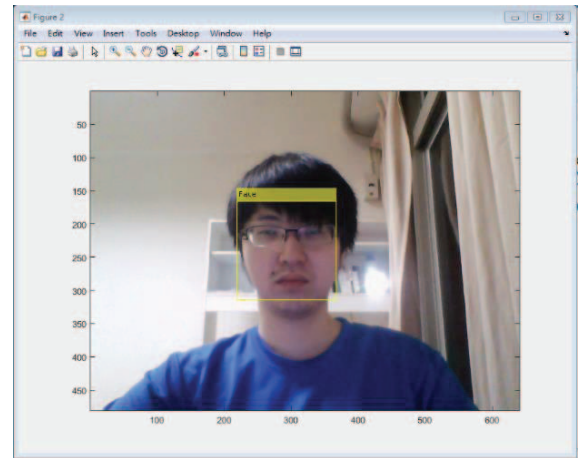


Figure .6 Adding corresponding axis for the face detection module

4. The center of the chest is known experimental position, we name the distance as v. The testing position is  $x = x1 + (v/2)$  and  $y = y1 - 2v$ . Once we obtain the x and y axis positions we will send it to the Arduino.

#### Arduino control

1. When we obtain the testing position, we can use Matlab Simulink to control the servomotor.
- 2.

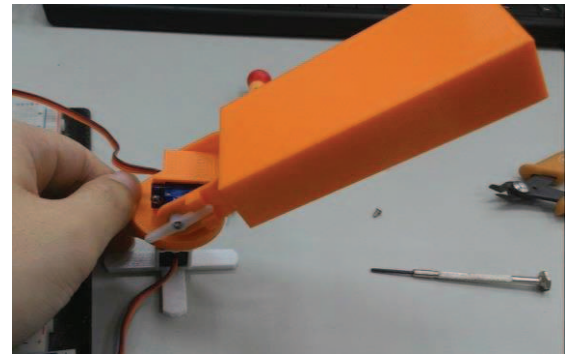


Figure .7 The arm of the Doctor robot

3. The 3D printing technology can print the robot's arm, there are 2 servomotor. With the given information, x-axis controls the motor's base (moving left and right) and y-axis controls the top of the motor (moving up and down).



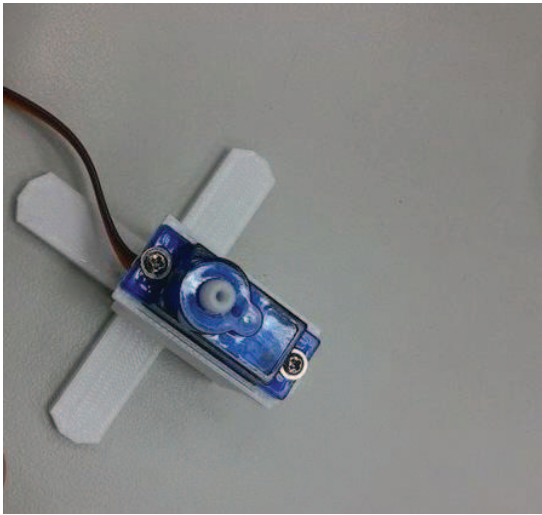


Figure .8 The actuator module of the Doctor robot for moving left and right

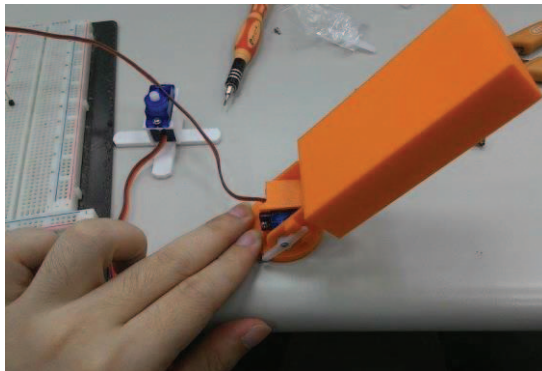


Figure .9 The actuator module of the Doctor robot for moving up and down

#### IV. CONCLUSIONS AND FUTURE WORK

In the future, IoT will be very important in medical field. Because aging society is coming and the lack of medical personnel is getting serious, some problems of medical care in Taiwan even around the world will be much more. Thus, Doctor robot may be the way to solve those problems.

Also, we can use a Doctor robot to supervise the vital signs for chronic patients for 24 hours. According to the data from the portable detecting device worn by patient, doctor can easily trace the health of the patient and give them proper treatment [19].

Besides, our data transmission depends on the Internet, so the security will also become a big issue.

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