Lab2实验报告

实验内容

服务器对时程序：一个服务器，多个客户端，客户端可以给服务器连接请求并返回服务器时间并对时。

实验平台和语言

Ubuntu 20.04.5 LTS (Focal Fossa) 64 bit

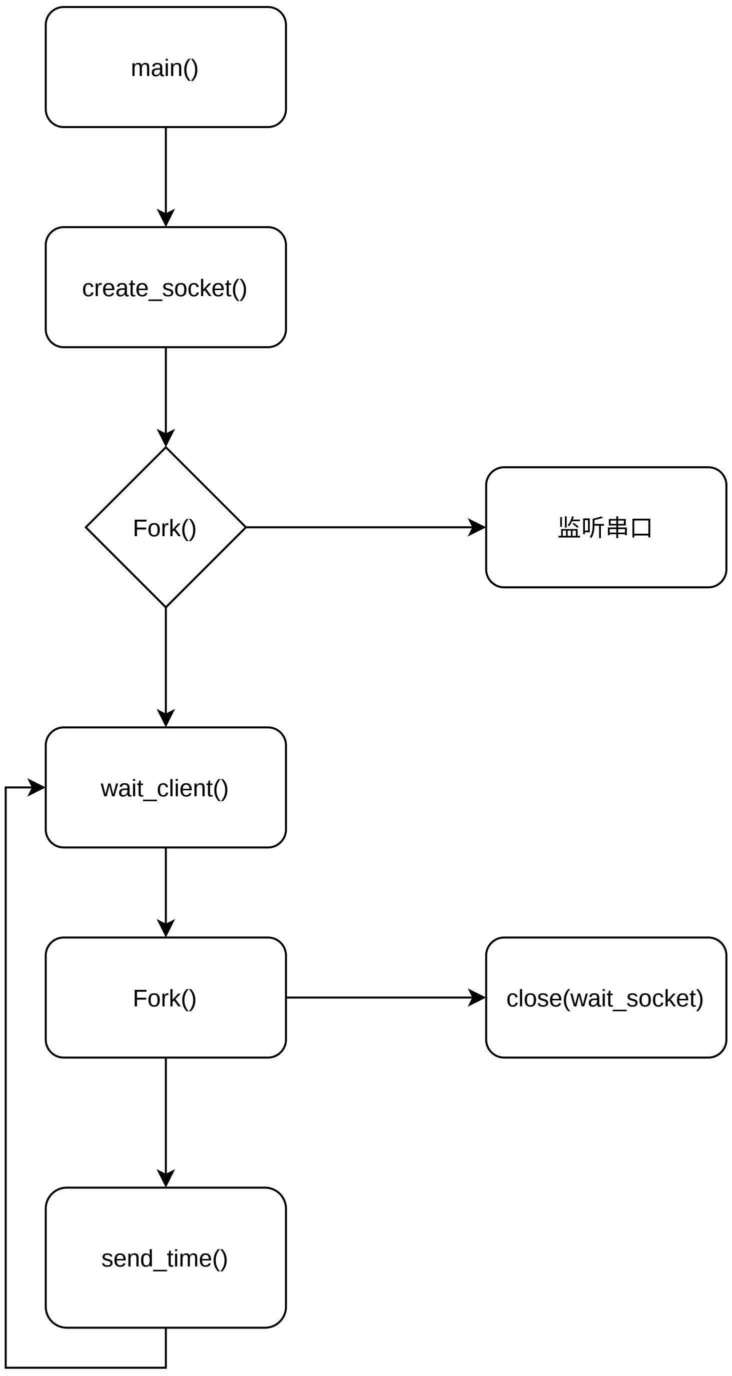
C Language

gcc version (Ubuntu 9.4.0-1ubuntu1~20.04.1) 9.4.0

实验过程

服务器端

程序流程图



主要变量和函数的说明

1. create_socket()

```
int create_socket(){
    int sockfd;
    struct sockaddr_in servaddr;

    if((sockfd = socket(AF_INET, SOCK_STREAM, 0)) < 0){
        printf("create socket error: %s(errno: %d)\n",
strerror(errno),errno);
        exit(0);
    }

    memset(&servaddr, 0, sizeof(servaddr));
    servaddr.sin_family = AF_INET;
    servaddr.sin_port = htons(DEFAULT_PORT);
    servaddr.sin_addr.s_addr = htonl(INADDR_ANY);

    if(bind(sockfd,(struct sockaddr*)&servaddr,sizeof(servaddr))==-1){
        printf("bind socket
error:%s(errno:%d)\n",strerror(errno),errno);
        exit(0);
    }

    //Start to listen the socket
    if(listen(sockfd,10)==-1){
        printf("listen socket
error:%s(errno:%d)\n",strerror(errno),errno);
        exit(0);
    }

    printf("===============waiting for client's
request===============\n");

    return sockfd;
}
```

创建Socket接口，绑定至DEFAULT_PORT端口，开始监听。绑定时，需要将IP地址转换为网络字节序，端口号也需要转换为网络字节序。选择合适的网络协议——TCP/IP协议。

2. wait_client(int listen_socket)

```
 int wait_client(int listen_socket){
     int connfd;
     struct sockaddr_in cliaddr;
     socklen_t clilen;
     char buff[MAXLINE];
     int n;

     while(1){
         clilen = sizeof(cliaddr);
         if((connfd = accept(listen_socket, (struct
sockaddr*)&cliaddr, &clilen))==-1){
             printf("accept socket
error:%s(errno:%d)\n",strerror(errno),errno);
             continue;
         }

         //print the client's information
         printf("Success to connect with
client:%s\n",inet_ntoa(cliaddr.sin_addr));
         return connfd;
     }
 }
```

该程序等待客户端的连接请求，当有客户端连接时，返回连接套接字。

3. send_time()

```
void send_time(int listen_socket, int client_socket){
    char *buff;
    int n;
    time_t ticks;

    time(&ticks);
    buff = ctime(&ticks);

    printf("Send time to client:%s\n",buff);
    if(send(client_socket, buff, strlen(buff) + 1, 0) == -1)
perror("send error");
    close(client_socket);
}
```

该程序将服务器的时间发送给客户端，并关闭连接套接字。

4. main()

```
int main(int argc, char **argv){
    int listen_socket = create_socket();

    int p = fork();
    if(p == -1){
        printf("创建子进程失败\n");
    }
    else if(p > 0){
        char c;
        c = getchar();
        if(c == 'q'){
            printf("再见！\n");
            close(listen_socket);
            exit(0);
        }
    }
    else{
        while(1){
            int client_socket = wait_client(listen_socket); //多进程服务
器，可以创建子进程来处理，父进程负责监听。
            int pid = fork();
            if(pid == -1){
                perror("fork");
                break;
            }
            if(pid > 0){ //父进程只负责监听
                close(client_socket);
                continue;
            }
```

```
                if(pid == 0){
                    close(listen_socket);
                    send_time(listen_socket, client_socket);
                    break;
                }
            }
        }
    }
```

需要注意的是我们的服务器是多进程的，父进程负责监听，子进程负责处理客户端的请求。当父进程接收到客户端的连接请求时，会创建一个子进程来处理客户端的请求，父进程继续监听。当子进程处理完客户端的请求后，会关闭连接套接字，然后退出。

并且我们创建了一个进程监听串口的输入，当用户输入q时，服务器会关闭。

客户端

客户端程序较为简单，创建一个socket，连接到服务器，然后接收服务器发送的时间信息。并将时间信息打印出来即可

```
int main(){
    int client_socket = socket(AF_INET, SOCK_STREAM, 0); //Set up a socket
    if(client_socket == -1){
        perror("socket");
        return -1;
    }

    struct sockaddr_in addr;
    memset(&addr, 0, sizeof(addr));

    addr.sin_family = AF_INET;
    addr.sin_port = htons(DEFAULT_PORT);
    addr.sin_addr.s_addr = htonl(INADDR_ANY);
    inet_aton("127.0.0.1", &(addr.sin_addr));

    int addrlen = sizeof(addr);
    int listen_socket = connect(client_socket, (struct sockaddr *)&addr,
addrlen);  //Connect to the server
    if(listen_socket == -1){
        perror("connect");
        return -1;
    }

    printf("Success to connect server!\n");

    char buf[SIZE];

    if(recv(client_socket, buf, SIZE, 0) == -1){
        perror("recv");
        return -1;
    }
    printf("synchronization time: %s\n", buf);

    close(listen_socket);

    return 0;
}
```

程序操作过程

1. 编译服务器端程序

   ```
   gcc -o server server.c
   ```

2. 编译客户端程序

   ```
   gcc -o client client.c
   ```

3. 运行服务器端程序

   ```
   ./server
   ```

4. 运行客户端程序

   ```
   ./client
   ```

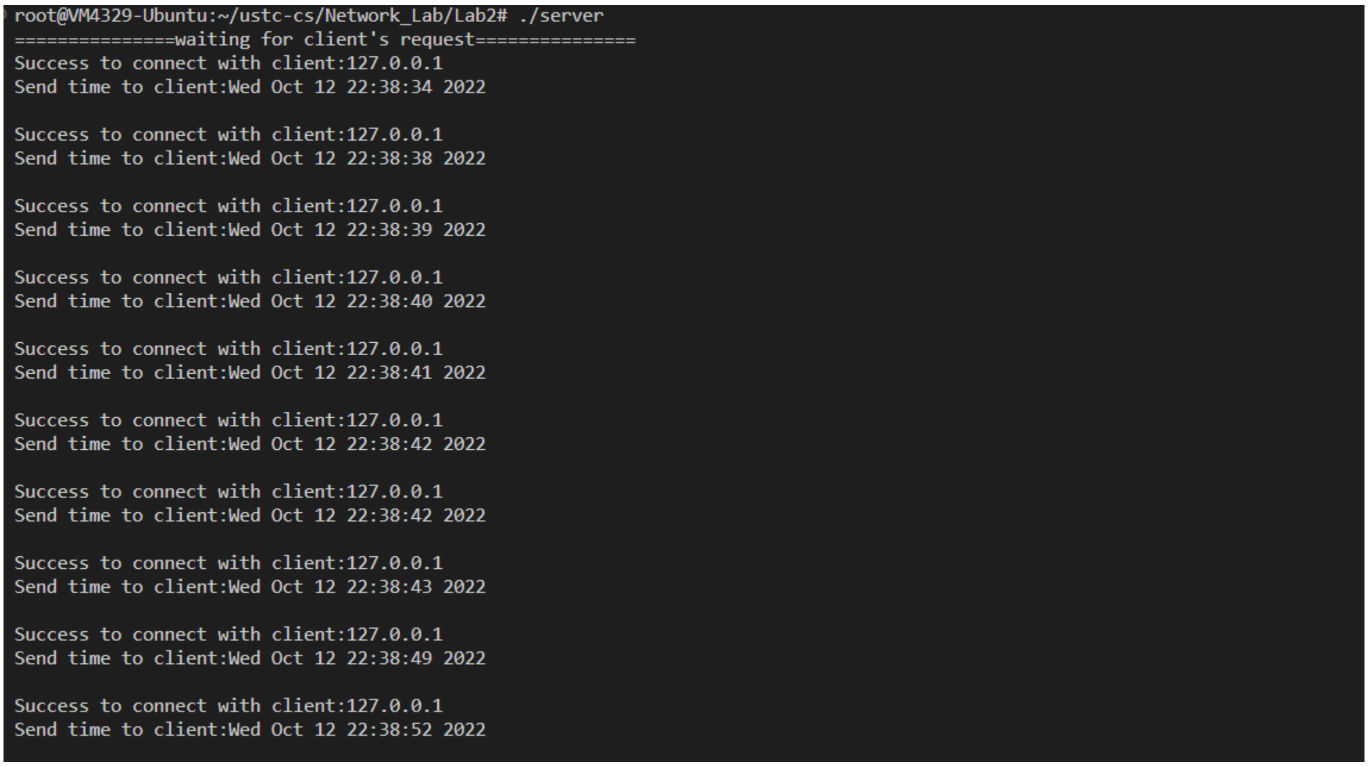
即可完成授时操作，并且我们可以在服务器端输入q来关闭服务器。

值得注意的是，我们编写的服务器是多进程的，也就是意味着它可以满足多个客户端的请求。当我们运行多个客户端程序时，服务器端会为每个客户端创建一个子进程来处理。

请确保DEFAULT_PORT端口没有被占用。该端口可以在`DEFAULT_PORT.h`中修改。当前的端口为：19999

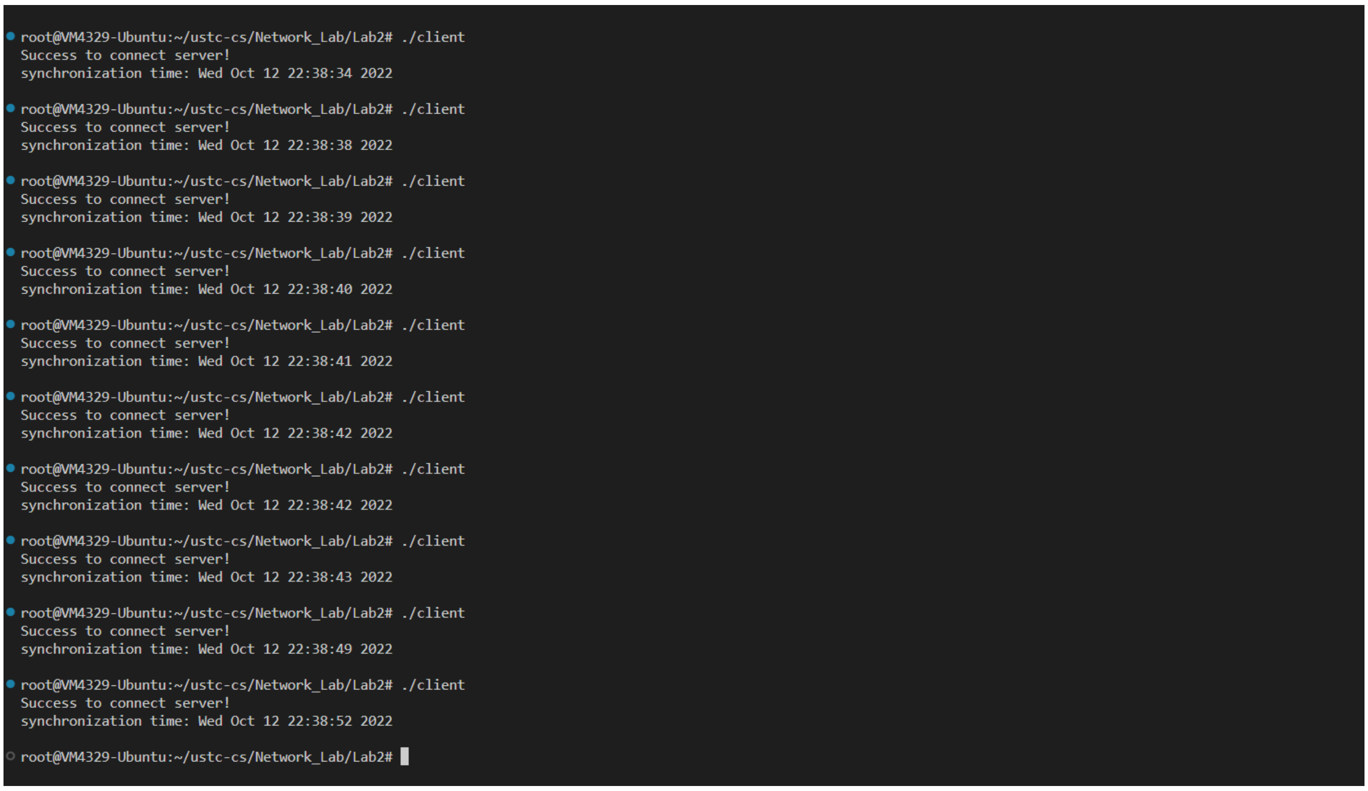
实验结果

服务器端



```
root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./server
===============waiting for client's request===============
Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:34 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:38 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:39 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:40 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:41 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:42 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:42 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:43 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:49 2022

Success to connect with client:127.0.0.1
Send time to client:Wed Oct 12 22:38:52 2022
```

客户端



```
root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:34 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:38 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:39 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:40 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:41 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:42 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:42 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:43 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:49 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# ./client
Success to connect server!
synchronization time: Wed Oct 12 22:38:52 2022

root@VM4329-Ubuntu:~/ustc-cs/Network_Lab/Lab2# 
```

可以从图中看出成功完成了授时同步！