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WIRELESS CUSTOMER PREMISES EQUIPMENT FOR LANDLINE

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ABSTRACT

According to current scenario the conventional telephone system is degrading day by day. This situation leads to damage of entire cable telephone system. Conventional telephone system provides good voice quality than GSM and CDMA, but its usage is diminishing due to its immobility. So the prime concern of this project is to provide user mobility at the customer premises equipment. This project is to find a wireless replacement for the conventional landline telephone receiver with providing mobility to user and satisfying the voice quality requirement with our Android phone. It provides the voice quality of conventional landline phone with full duplex data rate of 128 kbps. This project equips the above facility with any android phones and maximizes the utilization of land line call offers such as "free unlimited night calling, and Sunday unlimited calling".

***Keywords*: Android minicomputer, ATmega328, Bell ring detector, MCU module, WCPE.**

I. INTRODUCTION

In current scenario, the landline calls mobility is restricted to specified or fixed locations. Right now landline customer premises equipment's are available as fixed terminals , which restricts the mobility of users which also restricts the utilization of landline features such as voice clarity (64 kbps no real time compression, crystal clarity speech), free night charge calling facilities . Our proposed system is landline customer premises equipment which enables the user mobility and users equipment reliability. Our CPE is Wi-Fi operated device which connects to the conventional PSTN network and it creates a Wi-Fi hotspot which implies a modulation scheme of conventional PSK and a WPA 2 encryption which can be accessed from any conventional Android phone. Android phone which is connected to Wi-Fi network created by the proposed system can receive as well as initiate landline call, from that mobile phone Wi-Fi zone enables the user mobility as conventional Wi-Fi zone. Our proposed WCPE is based on node MCU module (CP 2103) which has an in built Wi-Fi module and operates on 5v power supply. CP2103 has both analog and digital I/O pins. Analog pins detect the dial tone of landline. CP2103 has an in built ESP8266 based Wi-Fi module which enables the input based wireless connectivity between mobile station and CP2103 microcontroller. CP2103 samples the analog channel at 8 khz and quantized into 8 bits and send it over Wi-Fi network at 64 kbps speed to mobile station. The mobile station takes the input from microcontroller and sends the speech signals over Wi-Fi network. The main challenge of

this project is to establish a wireless speech transmission system over Wi- Fi and an Android application which is suitable for the application.

II. OBJECTIVES

According to current scenario the conventional telephone system is degrading day to day. It provides good voice quality than GSM and CDMA, its usage diminishing day to day due to its immobility. So our prime concern is to provide user mobility at the customer premises equipment. Objectives are

1. To find a wireless replacement for the conventional landline telephone.
2. To achieve the above result with our Android phone.
3. To provide the voice quality of conventional landline phone with full duplex data rate of 128 kbps.
4. To equip the above facility with any Android phones. And maximize the utilization of land line call offers such as "free unlimited night calling , and Sunday unlimited calling"

III. APPLICATION/SOCIOECONOMIC IMPORTANCE

Some years back, Land line industry was a monopoly in telecom sector. After the introduction of mobile phones the conventional telephony usage is degrading day by day. To reduce the dropout of landline customer, Land line telecom providers (BSNL govt of India enterprise) provides more and more free calling offers to the customer. In current scenario, even though the land line customer drops out day by day due to immobility and taping ability of conventional telephones. So this paper thought for the solution.

1. To reduce the dropout of landline customers.
2. To provide user security and mobility for the conventional landline telephony.
3. To survive the conventional telecom landline CFA sector by giving a rebirth to the landline telephony. (Huge amount has been invested in landline CFA sector by BSNL). There by providing a new opportunity to the land phone communication.
4. To develop this product and market industrially in an economical current progress.

IV. IMPLEMENTATION DETAILS

The proposed WCPE implementation includes some sub circuits design, study and experimentation regardless of its size or impact. We could experiment and develop some add on circuitry to automate a conventional telephony circuitry. Bell ring detector circuit, pulse dialing circuit, and electromechanical relay based off hook switch, speech amplifier, and hybrid circuit are some examples of our experimentation.

4.1 Block Diagram

The fig (i) shows the Block diagram of proposed WPCE (Wireless Customer Premises Equipment) system.

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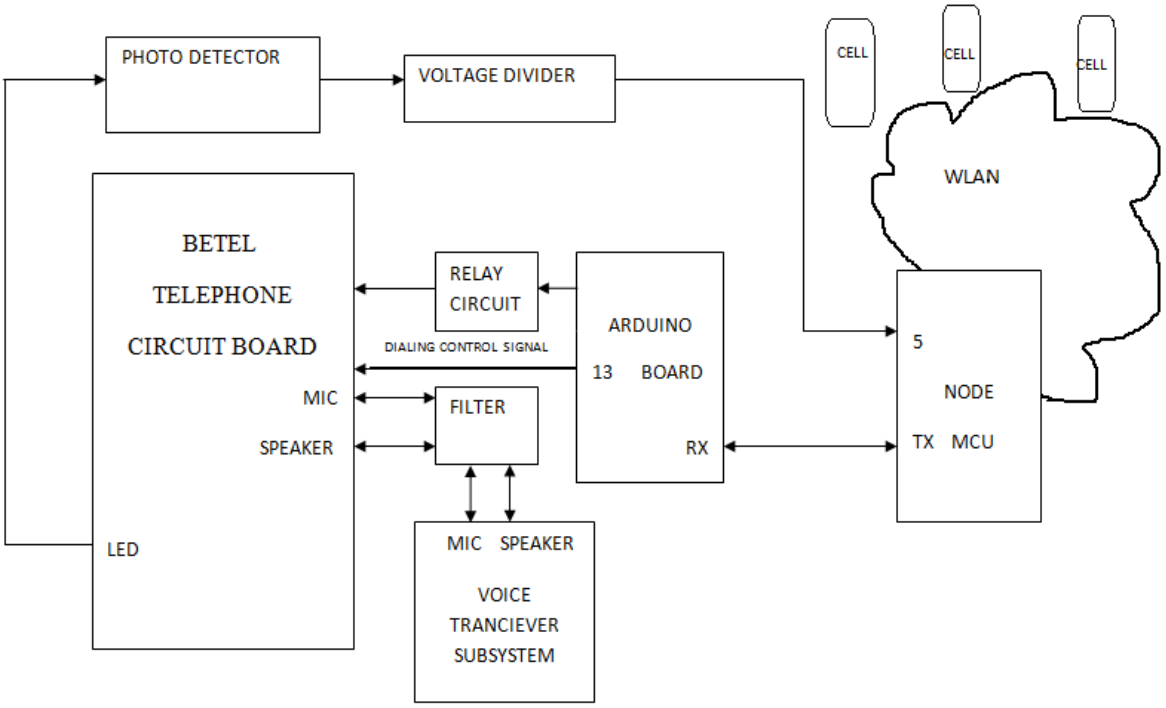

Fig (i) Block diagram of proposed WCPE

4.2 Beetel's EPBT Board

This is a conventional analog EPBT circuit board, which has off/on hook switch, analog audio input/output, bell ring LED indicator, DTMF dialer, pulse dialing circuitry etc…we are utilizing this pins for automating the conventional receiver. Fig (ii) shows the Beetel's EPBT board.

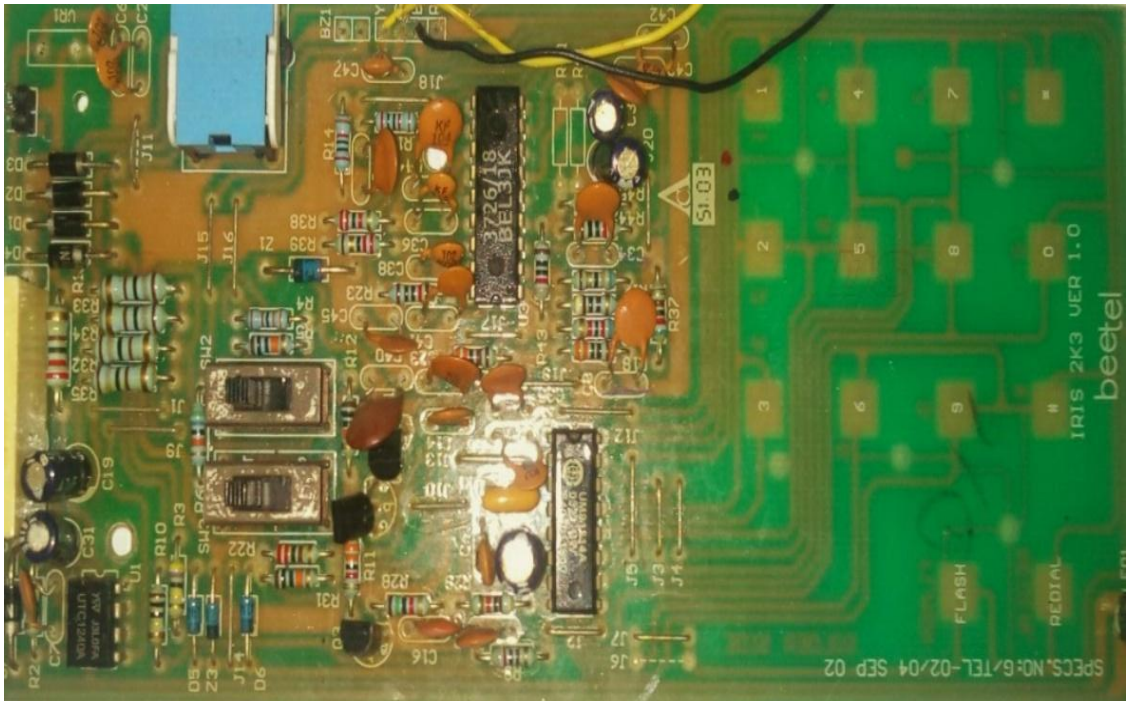

Fig (ii) Beetel's EPBT board

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On Beetel's EPBT board, conventional on hook switch is replaced with a double contact relay. Then this relay is actuating from Arduino uno pins. Hence off hook and on hook can be controlled via Arduino uno board.

4.3 Lolin's Node MCU

Node MCU module has an in build ESP8266 based wifi transceiver, which is capable of creating a wifi hotspot region with WPA2PSK authentication. It has 16 GPIO pins which can be configured both as input or output and an analog input pin for interacting with analog input signals. Node MCU is capable of establishing IP based connectivity in one network. This is capable of handling an http server, DHCP server etc,it has USART interface for communicating with microcontrollers. This is utilized for interfacing with Arduino board. Node MCU run on a clock frequency of 80MHz and wifi module has a band of 2.4 GHz. Fig (iii) shows the node MCU module.

Fig (iii) Node MCU module

LoLin's node MCU module has ESP8286 based wifi module, which is wirelessly connected to android minicomputer and user android phone. An http server is created on node MCU module for interacting with control requests from android user. Node MCU module is also connected to Arduino uno via USART pins. A half-duplex connection is established between node MCU and Arduino uno to send control words from node MCU to Arduino board. Bell ring detector circuit is connected to node MCU through a potential divider level converter. (GPIO second pin is connected to the bell ring detector circuit).

4.4 Arduino UNO Board

This Arduino uno board is the basic platform board of Arduino board. Which is based on an ATmega 328 microcontroller, which has digital and analog pins, USART, TIMERS, COUNTERS, etc. This can be programmed using Arduino IDE. This is used here for actuating pulse dialing signal.

Arduino's digital pin 12 is connected to off/on hook relay (for actuating relay whenever is required). Arduino digital pin 13 is connected to pulse input pin of Beetel's conventional telephone board (for giving dialing pulses).

4.5 Lm358 Based Bell Ring Detector Module

LM358 is an opto isolator, used for detecting the bell ring. LM 358 based opto coupler board is connected to bell ring out put pin of the Beetel's EPBT board (which provides an optical isolation between high voltage EPBT board and low voltage node MCU board).

4.6 Voltage Level Convertor

Voltage level convertor is a potential divider based 5v to 3.3v converter. is used to couple the bell ring signal to node MCU's GPIO input pin.

4.7 Audio Coupling Circuits

Resistance capacitance based RC coupling is employed between audio input/output of EPBT board and audio output/input of android minicomputer which also isolates high dc bias exists on EPBT board.

Audio out of EPBT board is connected to audio in of android minicomputer. Audio out of android minicomputer is connected to audio in of EPBT board. An RC coupling is employed between audio in/out of EPBT and audio in/out of android device for getting isolation to android device from high DC bias of EPBT board.

V. WORKING

All the boards of all the sub systems are connected in such a way as shown in connections. The working and coordination of each subsystem and circuitry is mentioned below. The circuitry as shown in Fig (iv)

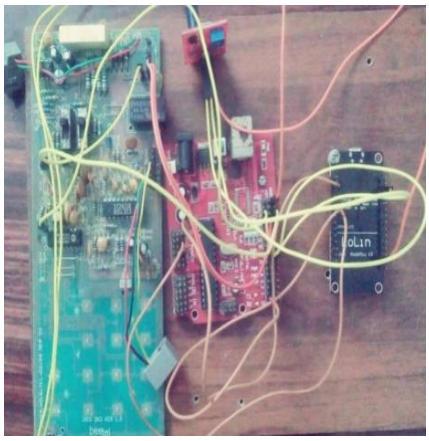

Fig (iv) Circuit board of WCPE

5.1 For Initializing an Outgoing Call

Our android applications have a dialer screen which provides an app interface for the user to dial a number. After dialing a number the user tap on call button. When tap on call button, the app reads the dialed number

from edit text field of android application and it sends a get request to the http server created on node MCU in the below format.

http://number?=xxxxxxxxxx&status?=0&ringstatus?=0

It also establishes full duplex voice communication between phone and minicomputer. When node MCU receives the above get request, it segregate the phone number xxxxxxxxxx from the URL request and send it to Arduino board at a bourd rate of 9600 bps via USART pin.

Arduino board receives the above phone number. It first actuates the on hook relay and waits for one second. Then it generates the pulse dialing signal for the input number from node MCU. The pulse signal is coupled to the pulse dialing input of EPBT board. Hence dialing occurred.

At this time audio in and out of EPBT is available at the audio input/output of EPBT board. This is coupled to the android minicomputer. It digitizes the analog voice and send over wifi to the user android phone. Hence incoming speech is received at mobile station. At the same time mobile station receives the speech via its microphone and digitizes it. Then transmit it to android minicomputer with a speed of 128kbps (8 KHz sampling and 16 bit quantization). This digital speech signals is converted to analog output on android minicomputer using DAC and reconstruction filters. Then it is coupled to analog-in of the EPBT board. Hence two way voice transmissions enabled and call is in progress. Hence two way speech is available at mobile stations. After the completion of an ongoing call, the user has to complete the call.

5.2 For Disconnecting a Call

While a call is ongoing the user activity screen will provide an end button to disconnect the call. When user taps on end button, the mobile application sends an http get request to the http server in the below format:

http://number?=xx&status?=1&ring status?=0

When server receives this request, it will intimate the arduino to turn off the on hook relay. Then Arduino will turn off the on hook relay and hence the call is disconnected.

5.3 For Receiving Incoming Calls

Our android application will send a get request to help server every 5 seconds to check whether a call is available or not. The format is as given below.

http://192.168.4.1/number? = xx & status? = 0&ring status? = 1

When receiving this URL the server checks the GPI02 pin whether any incoming call is getting, or not. If there is any incoming call coming the server replies to the above query that it is “ringing” otherwise replies that “not ringing”. When the app receives the ringing reply from the server it will alert ringtone for user alert and an activity will start with an attend button. When user presses on attend button, the app will send another http request.

http://192.168.4.1/number?=xxxxxxxxx&status?=2&ring status? = 0

When node MCU gets this request it will alert the Arduino to turn onhook relay and thus turned on the relay. So land phone is attended and voice transmission between android transcoder and android app will be enabled. Hence voice is transferred and call is established. During an ongoing call the app will turn to call and activity with a call end option. When user presses the call end button, the app will send a request.

http://192.168.4.1/number?=xxstatus?=1&ring status?=0

When node MCU receives this request, the node MCU will intimate the Arduino to turn the on hook relay. Then Arduino will turn off the on hook relay. Hence call is terminated.

VI. RESULTS

The WCPE system virtually replaced the conventional telephone system by android phone. At the installation time configured the android devices in minicomputer system using IP Address and port number through developed application. After installation of this WCPE device, initiated a call from our android phone with telephone number. The number was dialed at dial field of the application and taped the call button and generated the call. Incoming call to the telephone number was accessed by android phone. When call arrived, the incoming call was displayed on the application and a dialer tone was generated on android phone. The call was attended using the call attend button in the application.

VII. CONCLUSION

WCPE system has replaced the receiver section of conventional landline phone with an android phone and provides mobility to the user. The proposed system is to create a communication link between smart phone and land phone using WiFi network. It is found that Real-time voice transmission is possible through WiFi without any delay. For this purpose, a new protocol is developed which could transmit voice data over WiFi network. For the dialing purpose the WCPE is used Pulse Dialing Method instead of the existing dialing techniques in land phones (DTMF). The Digital data from the Android mobile device converted to Analog, using Digital to Analog Converter Module in the hardware section. The Android application which would replace the conventional land phone receiver. This application includes dialing pad, call button, call end button, call attend button and delete button.

Future scope of this proposed WCPE for land phone, would create a complete IP based WLAN network platform for VoIP communication and also using this same network initiate calls between WLAN connected Android devices.

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