

Master Slave Configured Voice Communication using Power Lines

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Abstract: Communication is the basic need of an individual in his day to day life. There exist two forms of communication: wired and wireless communication. PLC is one such wired communication technology that is being highlighted in this paper. The electric power supply system is now not limited to pure power distribution but it also acts as a multipurpose medium with different application like voice, data services as well. Making use of PLC technology to establish voice communication in a master-slave configuration (similar to intercom) is been described. The prototype described can be modified and improved for future applications. It uses the already existing power lines. Power transmission is achieved by using the principle of superimposition of voice over power in power-line cables.

Keywords- Communication, Master Slave, Power Lines, PLL.

I. INTRODUCTION

Communication signals sent on the same pair of wires which are also used for power transmission can be thought of as early as the telegraph itself. One might also think that this idea may have been overshadowed until recent decades. But, it is not as such there were at least two patents were issued to the American Telephone and Telegraph Company in 1920's. PLC technology is transmitting of data or information through the power lines which are also used for transmitting of power. The data to be transmitted is modulated sent over power lines and at the receiver side it is demodulated. Since, power lines are present in every abode, dwelling, public places, etc. this technology can be implemented. The idleness of the power lines can be exploited. Apart from pure power transmission the power lines are not used for any other purposes. So to make use of this idleness we can implement the PLC technology in homes, buildings and many places. The voice signals can also be transmitted/ sent over the power lines and this is known as voice communication using power lines. The voice signals are modulated at the input side and are coupled over the power lines for further transmission to the receiver side.

The prototype described in this paper is used for voice communication in a building with limited range of communication but with master-slave configuration. The master-slave configuration of this prototype means the master device can communicate with any of the slave

devices but whereas the slave device can communicate with the master only. This prototype works similar to as that of telephone device.

II. PROTOTYPE DESIGN

The master slave configuration highlighted in the introduction is the main idea behind this prototype, or can be called as the base of this prototype. The M-S configuration of this prototype is shown in fig 1. The master can establish a call to any of the slaves, but the slaves can establish the call only to the master. Whether the master establishes the call or the slave establishes the call, communication between them would be full duplex.

The block diagram of master slave configured voice communication prototype is shown in fig 2. The mains coupling unit is responsible for the imposing of voice signals over the power lines. The signal to be transmitted must be tuned before transmitting and it is done by the tuning section. The PLL transreceiver and DTMF encoder/decoder are combined to act as the heart of the prototype. The DTMF encoder is used to establish a call from the master to a particular slave.

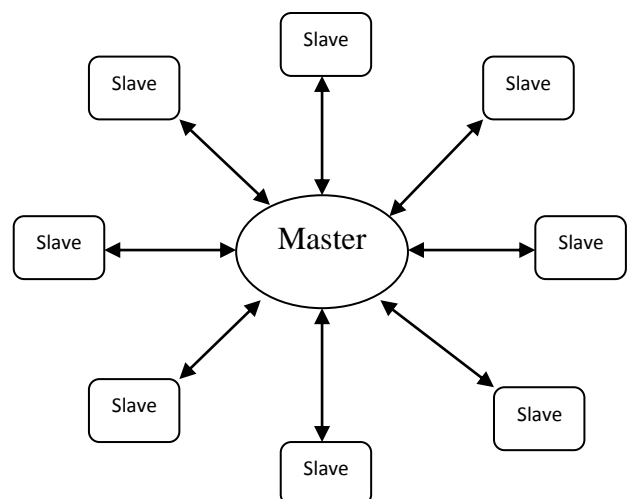


Fig: 1. Master-slave configuration.

In M-S configured voice communication the same prototype is used for transmission and reception with some changes in the master prototype. The master prototype has an extra function of DTMF encoding when compared to that of slave prototype. Only one Phase Lock Loop (PLL) is used to modulate and demodulate the signal before transmission and after reception. By virtue of which the transmitter and receiver are aligned. To make the user alert ring tone generator is used and is connected to the speaker, this speaker is also used to listen the voice received. The carrier signal is separated by the coupling unit which is connected to the AC mains and then fed to the PLL block. The frequency of Voltage Controlled Oscillator present in the PLL block is set to carrier frequency, now the frequency deviation/ variation in the carrier is reflected as voltage deviation/variation at the output of PLL block. This signal is the demodulated signal. It is then fed to an audio amplifier for amplification and given to the speaker.

Power lines:

Power lines acts as a channel or medium to carry the information. The described prototype would establish the connection between two devices where the length of the power line is not more than 100 meter. Main challenge faced is the electrical and electronic instruments attached to the power line that consume high load.

Microphone:

The microphone is used to convert the audio speech signals into electrical signals. In this prototype the microphone used is of capacitance change type (condenser MIC) to convert the signals from air pressure variations. Before the signals are further processed they must be fed to preamplifier.

Pre amplifier:

Pre amplifier is also known as electronic amplifier as it improves the quality of the signal. It amplifies the received signal to level where the signal can be processed or can travel further. The noise or the interferences from the microphone (sensor) affecting the signal quality can be reduced. Boosting the signal strength is main work of preamplifier.

PLL transceiver:

The phase locked loop consists of variable frequency oscillator and phase detector. The PLL is also used to demodulate the modulated signal and also to retrieve the signal from a noisy channel. The working of PLL in transceiver is controlled by the duplexer.

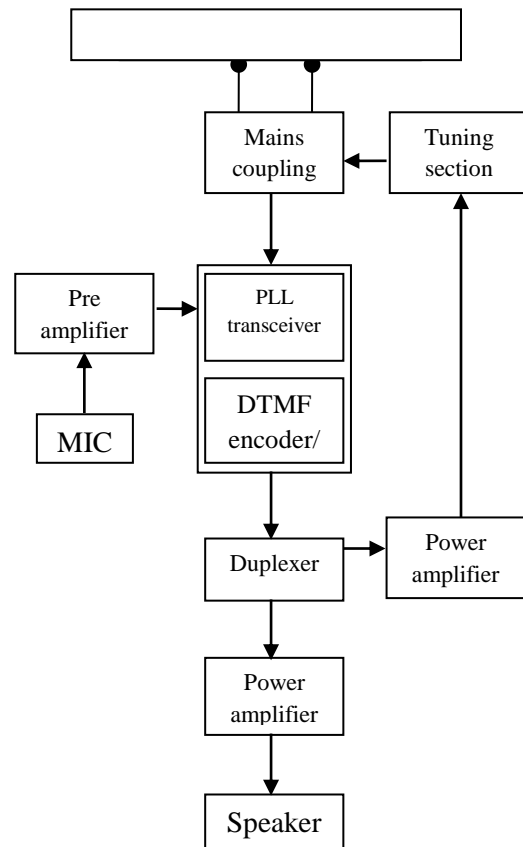


Fig. 2. Block diagram of master-slave configured voice communication using power lines.

DTMF:

Dual tone multi frequency is used in conjunction with PLL block so as to modulate the signal with a particular frequency. . Each digit in DTMF (dual tone multi-frequency) code corresponds to the combination of two discrete frequencies, one each from a low and high group of frequencies, which are generated when any switch on a dialer key-pad is pressed. Such a key-pad along with the frequencies associated with each row and column. The key-pad is used in conjunction with a dialer IC such as UM9214 or UM9215 to generate the pair of frequencies. The DTMF signals transmitted over the telephone lines can be received and decoded using a DTMF receiver/decoder IC such as UM92870 or KT3170 or Motorola's MT8870.

Duplexer:

The duplexer is a multiplexer and acts as digital switch. This change-over-switch is fast enough to change the units as transmitter or receiver, as per the need. The Duplexer is nothing but a digital switch, whose switching action takes place only if any one of two inputs goes low. The CD4093 has Quad 2-Input NAND Gates which are acting like Schmitt Trigger and gets triggered whenever anyone input goes low. In this master-slave configured Unit, IC's three NAND gates are used to carry over the switching action between PLL Transceiver and Power Amplifier with Speaker. The switching action again depends upon the condenser microphone, whose voltage variations (caused due to picked up voice signals) are fed as input to two NAND gates.

Coupling unit:

This block couples the Power Line Intercom unit with power line. This unit has power down transformer with its own power supply section. The bidirectional unit draws power and voice signals from this unit only. This unit also has a set of intermediate frequency transformers which are used to give selectivity and used for coupling purposes.

Power amplifier:

Power amplifier is used to amplify the audio signals to sufficient levels. The amplification is necessary since the signal has to travel a long distance till the other device and also it has to be loud enough to hear when connected to speaker.

Speaker:

Speaker is an audio output device and is used to transmit ring tone signals to attract the end user towards the device. When the hand set (not shown in figure but can be imagined to as that of a telephone) is on cradle this speaker is connected with Ring Tone Generator unit, thus rings whenever caller party lifts (switch is used to indicate the lifting action) his device to make a call. When called party lifts his hand set from cradle then the speaker gets connected with power Amplifier so that voice signals can be heard clearly.

III. TESTS AND RESULT

This prototype described is having one master kit and two slave kits. This prototype has been tested by keeping the master kit in one room and the slave kits in another two different rooms. The voice communication happened between the two rooms. The communication would not happen when the power was not there. Also, the challenge faced was the communication was partial when there was inverter supply power instead of mains power supply.

Set up:

All the three kits must be connected to different electrical sockets and turned ON (but the switch in the kits must be OFF since they act as lift of the handset). The figures below show the master kit and the slave kits of the described prototype.



Fig 3. The Master kit

The master kit is similar to the slave kit apart from the dial pad present in it. The master kit can call any one of the slave by dialing the number of the slave it wants to communicate. Initially the switches of the kits must be in OFF position. When the master kit wants to communicate with the slave it needs to turn ON the switch and then dial the slave kit number it wants to communicate.



Fig 4. The slave kit

Once it is done the signal is then processed and transmitted over the channel. At the receiver end the slave decodes the signal and finds whether the received signal is been transmitted for it or any other slave. Then the ring tone is generated and to establish the call the slave needs to turn ON the switch. When a slave kit wants to communicate with the master kit it just has to turn ON its switch and the signal is coded and sent over the channel (power line) at the receiver side the master kit needs to turn ON its switch to establish the communication. To terminate the communication the switch has to be turned OFF.

IV. ADVANTAGES

Additional wiring and the wiring cost is not needed since the power lines are already present in every building. It is very easy to implement it is just to get the device plug into the socket. It can also be detached when not in use.

V. DISADVANTAGES

Due to presence of high load instruments on the lines the voice attenuation and the addition of noise is likely issue. The presence of mains power is must.

VI. FLOW CHART

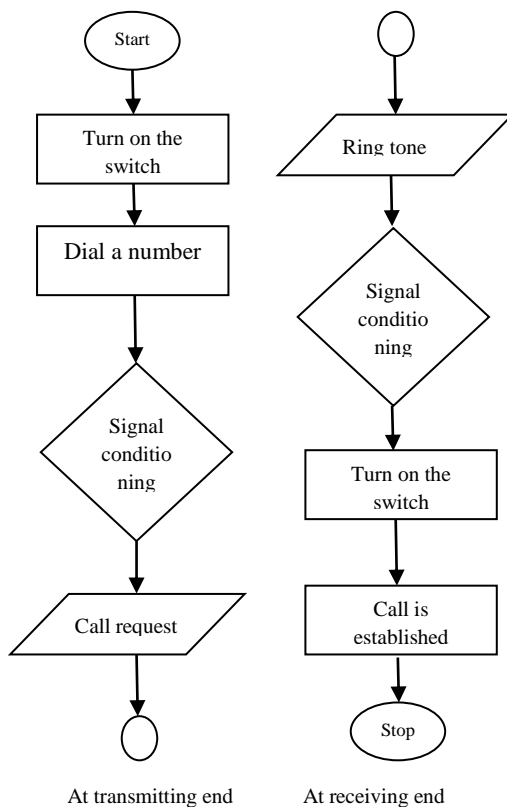


Fig. 5 Flow chart of M-S configured voice communication.

VII. APPLICATIONS

- Used to communicate within a school or college building.
- It can be used in industries to communicate between various departments.
- Used to communicate in homes.

VIII. FUTURE SCOPE

In conventional communication lines like coaxial cables and optical fibers, its standard transmission characteristics are developed, attenuation and impedance problems have been solved. On the other hand, when it comes to power lines which were originally made to supply pure electric power are now to be used also as communications paths, a high quality of engineering expertise is needed because their characteristics vary greatly and frequently. Factors responsible to the deterioration of the signal-transmission characteristics of power lines are the own losses of power line, affect from power-distribution devices which are connected to the power lines, noise created from those power-distribution devices, electrical home appliances.

IX. CONCLUSION

The power lines are also used for communication apart from the basic purpose for which they had been developed. This prototype is more applicable in small industries, schools or in hospitals where we want to communicate between various departments. This prototype provides promising service in its limited range. The communication over power lines has a wide range of future scope and applications as well. When considered a limited range of this technology it offers voice, data and other services. The PLC technology is reliable with future enhancements. The improvement in this field is limited by once thought only.

X. REFERENCES

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