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An Analytical Approach to Wireless Communication using Vodka Vapours

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Abstract: The aim of this article is to throw light on various emerging trends in wireless communication. This article focuses on molecular communication. The vision is to propose a system which can be utilised where and when conventional wireless technology is not appropriate, such as in a network of tunnels, pipelines, etc. with a recent research held in York University, headed by Prof. Andrew Eckford. They experimented and devised a network where messages could be transmitted using evaporated vodka. In this article, their work has been elaborated, analysed and a way on how this system can be implemented in day-to-day life has been discussed.

Keywords: Molecular communication, ITA2 standard, Channel propagation scheme, modulation and demodulation scheme, transmission rate.

I. INTRODUCTION

The indigence to transmit information over a distance has been an important part of the human history since its existence. Let it be the age old smoke signals that depicted danger, arrival of enemies for war or the traditional wired telephone lines, all of it ensured that men far away from each other were connected by some or the other communication medium. Contribution of Maxwell and Marconi in the field of radio technology is eminent.

Today, communication devices are available with the masses in various forms. Use of electromagnetic waves in mobile phones has made communication reach to almost each and every individual in the world. Satellite communication is another boon to monitor weather, determine position with GPS, broadcast information all around the globe, etc. Optical Fibre is another feather in the cap.

In spite of such advancements in the fields of communication there are some limitations in each of the above mentioned technology. For example, electromagnetic wireless communication systems can be very inefficient inside a network of tunnels, pipelines due to constraints like ratio of antenna size to the wavelength of the signal transmitted [1].

Inspired from nature, one possible solution is molecular communication. In molecular communication, chemical signals are used as carriers of information signal. One of the major drawbacks of molecular communication is the huge costs involved in its experimentation leading to a lot of development in theoretical aspects without any actual physical implementation [1].

Although, use of chemical signals for communication is not popular amongst humans it can prove to be very effective in transmitting information through burrows, pipes or underground structures. In this article, a molecular communication system used for sending text messages with chemical signals has been explained in detail and analysed to suggest some methods with which the productivity of this system can be enhanced.

II. MESSAGE TRANSMISSION SYSTEM

Every communication system comprises of the transmitter, the receiver and a channel. Block diagram of a basic communication system is shown in figure 1.

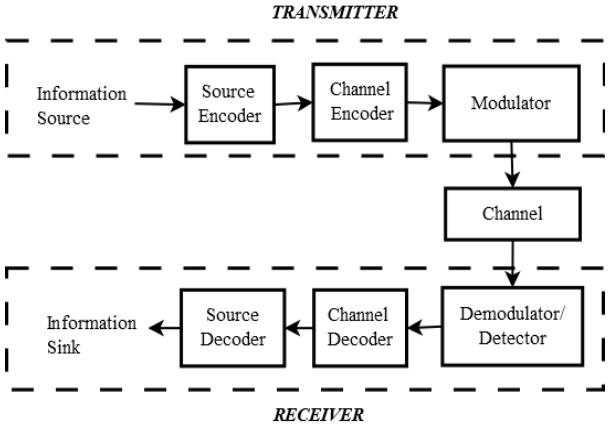

Figure 1: Block diagram of basic communication system [4]

In this messaging system, the information source is a keypad from which the user enters the text to be sent. The operation of the source encoder and the channel encoder is performed by an Arduino microcontroller board. An electronically controlled spray acts as a modulator while an alcohol sensor acts the demodulator/detector. Again, the source and channel decoding is done by an Arduino microcontroller board and the received signal is displayed on a computer screen. This system is designed and

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developed keeping in mind that the end product is inexpensive and can be easily programmed and modified. The details of each of the parts is as follows:

A. The Transmitter

All transmission operations are controlled by an ATmega 328 based Arduino microcontroller board. The transmitter consists of a LCD screen to display the text and 6 push buttons to enter the text. The user enters the text that has to be delivered. This text is converted into a binary sequence with the help of ITA 2 standard. The ITA2 standard is an international standard in which every alphabet is represented using 5 bits [6]. Table 1 shows the representation of various alphabets in the ITA2 standard.

Table 1: Representation of alphabets in ITA2 standard [6].

Alphabet	ITA2 Standard Representation
V	11110
O	11000
D	01001
K	01111
A	00011

This 5 bit sequence is then processed for transmission. To convert the binary sequence into its equivalent chemical signal, a spray is employed. The spray is controlled with an electronic switch. An Arduino Uno R3 board is used to control the switch. The modulation scheme used is based on a simple on-off keying where a binary 1 is sent with a spray of 100ms and binary 0 with no spray for 100 milliseconds [1]. The elements of the transmitter are shown in figure 2.

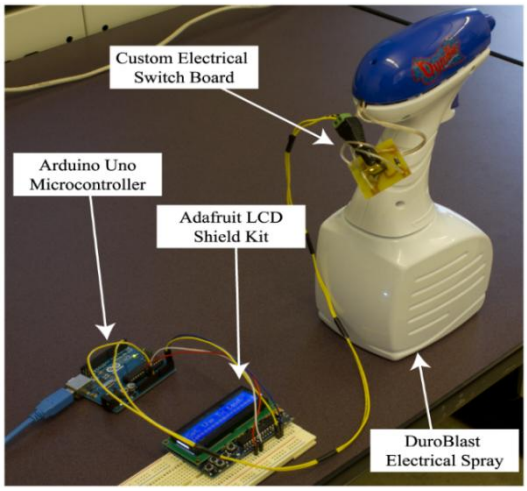

Figure 2: Transmitter Section of the system.

B. The Receiver

A sensor is used to detect the chemical signals on the receiving side. Three sensors were employed for this purpose; the MR513, MQ303 and the MQ3 sensor. The MR513 sensor signal output has a large amount of noise. On the other hand, the MQ303 sensor has a low system response voltage while, the MQ3 sensor has a better system response with the simplest circuitry. So, the MQ3 alcohol sensor is preferred. All the receiving operations are again performed by an Arduino Uno R3 board. The elements of the receiver are shown in figure 3.

C. The Propagation Schemes

The spray releases chemical signals whenever a binary one has to be transmitted. For this chemical signal to propagate through the channel to the receiver, two schemes can be looked upon:

1. *Diffusion Scheme*

In the diffusion scheme, the chemical released by the spray diffuses into the air and makes it to the receiver without any assistance. Though this scheme doesn't require any external energy for the transmission of the chemical signals, it is practically slow and very much unreliable.

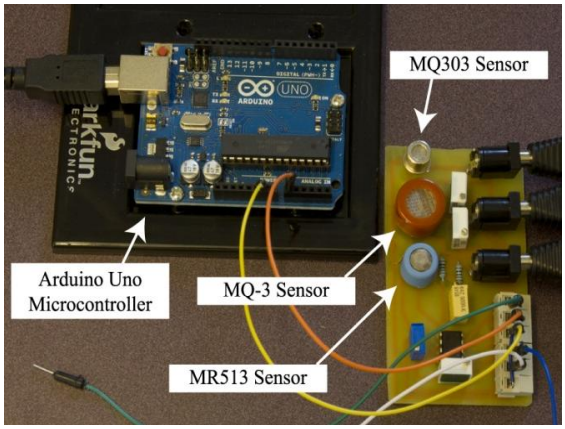

Figure 3: Receiver section of the system.

2. *Flow Assisted Scheme*

In the flow assisted scheme, the chemicals released by the spray are assisted by a fan placed behind the spray. Two different fans can be used for this purpose. One is a bladed fan and the other is a bladeless fan. The bladed fan is inexpensive but creates more of turbulent flows. The bladeless fan can generate laminar flows at required velocities needed to guide the signals efficiently towards the receiver. However, it is approximately ten times more expensive than its counterpart. So, in order to minimise the cost, a bladed fan is preferred. The flow assisted propagation method is employed in the transmission system as it has an agile and distinguishably better response than the diffusion scheme.

D. How the system works?

1. Transmission Operation

The user enters the text that has to be sent. This text is converted into a binary sequence as per the ITA2 standard. For encryption, start bit sequence '10' and stop bit sequence '00000' is appended to each and every alphabet to be transmitted. Once the text to be transmitted is ready, it is transmitted with the help of the spray. The spray releases the chemical for 100 milliseconds whenever the bit sequence has a bit 1 to be transmitted and releases no chemical for 100 milliseconds when a bit 0 has to be transmitted. The flowchart representation of the transmission process is shown in figure 4.

2. Reception Operation

Once the signal is transmitted by the spray, the concentration of alcohol in the atmosphere varies. These variations in the concentration of alcohol are measured by

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the receiver. If the concentration of alcohol in the surroundings increase, voltage readings of the sensor increases. Hence, the received bit is demodulated as bit 1. Similarly, if the concentration of alcohol decreases, the voltage reading of the sensor decreases and the received bit is demodulated as bit 0. Once the '10' sequence of start bits are detected, the receiver demodulates the 5 data bits followed by the '00000' bit sequence. The data bits are then decoded and the resultant character is displayed on the screen. The flow chart representation of the reception process is shown in figure 5.

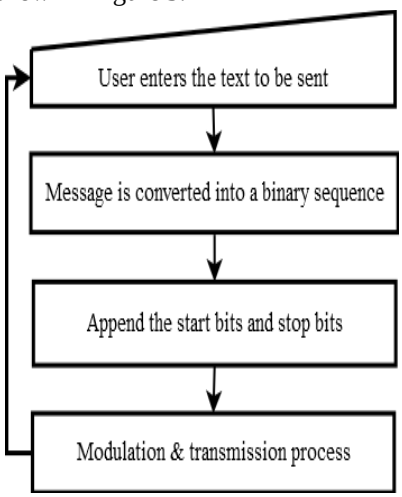

Figure 4: Flow chart representation of transmission process.

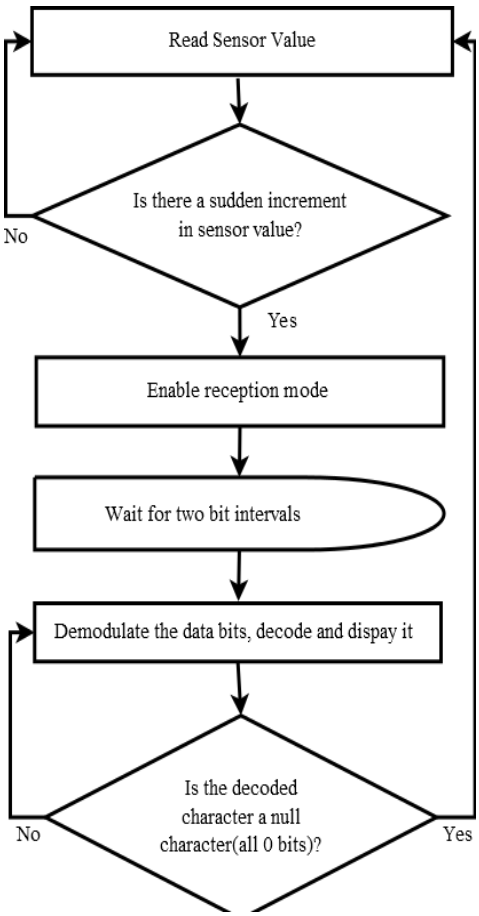

Figure 5: Flowchart representation of the reception process.

III. CHARACTERISTICS OF THE SYSTEM

A. Signal Modulation, Demodulation and Communication Protocol Design

This communication system utilises chemical signals to send messages from the transmitter to the receiver. This chemical that is sent through the channel to the receiver is stored in the spray at the transmitter. Owing to the size of the spray, a limited amount of chemical can be stored in it. Therefore, the overall design of the system has to be such that it utilises minimum amount of chemical in sending a good amount of message over the channel. The modulation scheme used in this system, called as on-off keying, effectively minimises the amount of chemical used.

The design of a communication system should be such that it is simple and works efficiently over longer distances. The first objective has been achieved but the second still needs a lot of considerations before implementing this system in day-to-day life.

To make the system secure and minimize the errors, start bit sequence '10' and stop bit sequence '00000' are chained to the 5 bit sequence before sending it to the transmitter. For example, if letter 'K' has to be transmitted then the overall bit sequence that is sent is '100111100000'.

B. Transmission Rate

One of the most important parameters of any communication system is the maximum speed at which data transfer can be carried out efficiently. This speed is greatly influenced by the method and equipment's utilised in the system. Here, it is affected by the type of scheme adopted for the flow of signals, rate of data transfer, sensor response and resume time, environmental noise, etc. With experimentation it was found that data rates of 1 bit in every 3 seconds (1 character in every 36 seconds) to 1 bit in every 5 seconds (1 character in every 60 seconds) were very reliable over a distance of 4 meters.

C. Signalling Chemical

A major part of this communication system depends on the signaling chemical used. The signaling chemical used must be highly volatile in nature as it affects the transmission rate. It should be widely available and inexpensive. Moreover, it should be safe and stable at various temperatures and low concentrations. Its persistence over a distance should be of prime importance while going for longer distances. The density of the signaling chemical is also vital. It should not be high as a considerable amount of power would be consumed for converting it into vapors. So, ideally the density of the signaling chemical used must be low.

IV. LIMITATIONS

- This communication system cannot be used in open air currently.
- The efficiency of the system is highly affected as the transmitter and the receiver are kept at longer distances from each other.

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- The system has a slow transmission rate.
- The sensitivity of the MQ3 sensor used is affected as a layer of alcohol is formed on it.
- The MQ3 sensor has a high resetting time.
- Propagation of vodka vapours as they encounter multiple paths, when used for underground communication is also questionable.

V. TROUBLESHOOTING

- For long distance communication, efficiency of the system can be maintained by cascading a multiple networks of transmitters and receivers.
- Propagation of vapours in a network of multiple paths can be implemented through wave guiding techniques.
- As it is difficult to direct the vapours in multiple paths, we can connect 'n' number of transmitters and receivers in 'n' numbers of multiple paths.
- In order to overcome the limitation of resetting time of the sensor, we can use a number of sensors with a flipping mechanism.
- With further research and advancements in molecular communication and nanotechnology, the drawbacks of slow transmission rate and time delay can be solved.

VI. APPLICATIONS

- This system can be effectively used in cloacae, calamities, etc.
- Since it is a new method in human communication, with enhancements it can be employed for transmission of confidential data with each of the 32 characters available representing some surreptitious information.
- It can be utilised for data transfer between robots and in surroundings where electromagnetic communication is dubious and unimaginable [1].
- Since this system is radiation free, it could be used to transmit data at places where radiation free environment is a must such as in cancer hospitals.

VII. CONCLUSION

The efficiency of the system can be much improvised by using more effective equipment. With further research, vodka can also be replaced by liquids having much higher volatility as it will increase the transmission rate and detection sensitivity of sensors. Fans with more wind speed and laminar flow can be used; this will reduce the time delay and also minimize the transmission error. It will also significantly increase the distance between the transmitter and receiver making the system useful for long distance communication. A new protocol for coding, having less number of bits can be designed which can also prove handy for increasing the transmission rate. With further research and advancements in this field, this system can be practically implemented in day-to-day life.

ACKNOWLEDGEMENT

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REFERENCES

[1] Farsad N, Guo W, Eckford AW (2013) Tabletop Molecular Communication: Text Messages through Chemical Signals. PLoS ONE 8(12): e82935. doi:10.1371/journal.pone.0082935.
[2] "What are they drinking? Text message sent using...vodka | Cutting Edge - CNET News" 07 Jan 2014 Available: http://www.cnet.com/news/what-are-they-drinking-text-message-sent-using-vodka/
[3] Jeremy Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry.
[4] George Kennedy, Bernard Davis, Electronic Communication Systems (3rd Edition).
[5] Louis E. Frenzel Jr., Principles of Electronic Communication Systems (4th Edition).
[6] Baudot Code, Murray Code & ITA 2 Standard Available: https://en.wikipedia.org/wiki/Baudot_code#Murray_code.

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