Proposing a System for Transmitting Information by Physical Contact between Subjects

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The present invention relates to a human body communication system and a communication device that transmit a relatively large amount of data via a human body with secrecy, with low power consumption, and without interfering with another communication system in a neighborhood. The system contains a wristband and special software that can be used to exchange business contacts and other information and put them into the user's contact list on the mobile device by just shaking hands.

Key words: Human body communication, Data transmission, Using a human body as a transmission path.

Wireless technologies for data transmission have become an integral part of our life. We use them to send text messages, to pay for goods, services or public transport, to identify or authorize people, etc[1].The most popular technologies are:

- RFID (Radio Frequency Identification). This system consists of a reader and a RFIDtags. The system operates in four available frequency bands: 125 134kHz, 13.56MHz, 860-960MHz, and 2.45 GHz. There is also a division by the communication range, power supply and memory type[2]
- NFC. This technology unites reader and tag in one device, unlike RFID. Aerial reach of this data transmission system is about 10 cm[3]
- RF Transmission. This is transfer by electromagnetic waves, for example, Wi-Fi and Bluetooth[4]
- Non-digital techniques. They include the exchange of paper or other non--electronic information carriers.

There are several fields where identification technologies, available now, are not applicable, are not sufficiently convenient for the end user, or are not at all involved. Unlocking personal electronics, providing access to information and premises, sending personal information, payment for goods and services (including tickets), process automation and logistics are part of such life areas. A significant number of different devices leads to inconveniences for the end user and too many unnecessary devices.

Another way to transfer data – via human body – is discussed in many papers. For example, in [5]authors propose a short-range wirelessconnectivity technology that uses the capability of thehuman body to transport a few signals providing communication between twoelectronically compatible devices.US Patent No. 6211799 B1 discloses a method and apparatus for transbody transmission of power and information where the signal that the transmitter applies to the human's body contains the data component,

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powers the receiver, and enables it to detect and decode the data[6]. US Patent No. 6223018 B1 presents an intra-body information transfer device that transfers a signal via a human body[7]. US Patent Application Publication No. 20110227856 A1 discloses a system, in which a user gets access through an identification device or badge or tag worn on the body, which applies the techniques of body coupled communication to create a kind of aura around the user[8].

The main difference of these technologies in reference to RFID and NFC is that there is no need to hold the devices at the acceptable distance. Data transfer will be carried out at the contact of body parts of the owners of wearable devices, or by direct contact of the devices.

The main difference in comparison to the transmission technology is that the energy consumption is minimal, since there is no intentional electromagnetic radiation during data exchange.

The main difference in reference to the non-digital techniques is the exchange rate, the absence of material support, which, in case of loss, is difficult to recover. There is no need to digitize data in case of exchanging contact information.

As communication via human body shows good performanceit was decided to create a system providing fast, simple and safe data transfer between devices.The solution provides the exchange of personal information and the authentication via the method of capacitive (or electrostatic) binding, in which the data are delivered through the transfer of energy through the capacitance produced by the human body.

The system comprising a wristband and special software can be used to exchange business contacts and put them into the user‘s contact list on the mobile device by just shaking hands.

Thus, advantages of the proposed system are the following:

— Exchange of personal or contact data via minor physical contact between the owners of portable devices;
— transmission of the authentication information to an external device for access granting;
— transferring data to an application on a mobile device or a personal computer;
— transmission of payment data to the cash register via the transducing device.

MATERIALS AND METHODS

The present invention relates to the field of data transmission and, in particular, to a human body communication system and a communication device that communicates data using a human body as a transmission path. The human body, in terms of the electrical signal, is a tank with a low impedance for signals with frequencies from 60 kHz to 12 MHz. This method allows the use of capacitive coupling of the signal at these frequencies.

The proposed system for transmitting information by physical contact between subjects can be used to exchange business contacts and put them into the user‘s contact list by just shaking hands (Figures 1, 2). It consists of a wristband that collects data and transfers it and software (application for Linux/Mac OS X/Windows or mobile application) and cloud service.

The person creates his own business card on the phone in the preinstalled application, providing his name, contact and another information. After that, he puts a wristband on the hand on which the business card is sent. When two people meet each other and shake hands, the information is automatically transferred from the first wristband to the second and then – to the phone of the second user.

The proposed solution includes the following elements:

— The device which is carried by the user and the system containing personal data and/or authentication information and operating the technology of data exchange by capacitive coupling;
— Applications for mobile devices (smart phones or tablets);
— Transducing devices which is conversing the method of exchange via capacitive binding into exchange method, implemented by a personal computer or mobile device;
— External device that implements the technology of data exchange by capacitive coupling;
— Server.

However, the proposed solution is valid for the following scenarios:

— Data exchange between wearable devices by capacitive coupling technology during the contact of body parts of their respective owners;
— Data exchange between the external device and the wearable device;

— data exchange between a wearable or external device and applications on the mobile device or personal computer using a device converter;
— Data exchange between the external device and the transducer;
— Data exchange between a wearable or external device and the server using a personal computer or mobile device with a connected device transducer.

Since the data exchange between the two wearable devices is an analog for a common bus with two connected devices, a separation of the devices based on the timing and frequency for transmission of data (so-called handshake procedure) should be introduced. This task can be accomplished using the following algorithm:

— Both devices periodically generate a baseband signal at random intervals and durations;
— The device finding an incoming signal during the waiting period generates an output signal of a fixed duration on a different frequency and switches to transmit or receive afterwards;
— The second device detects the incoming signal on a different frequency and at its completion enters the transmission or reception mode (opposite to the first device).

External device and transducing device implement a similar algorithm.

Fig. 1. Information transition.

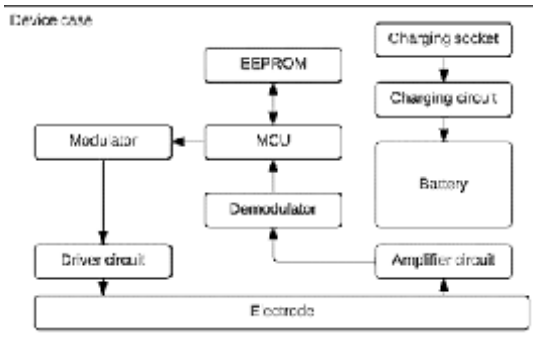

Fig. 2. Scheme of portable devices in scenario, when interaction takes place between two identical wearable devices.

Four aspects of the human body communication system of the invention are shown in a block-diagram form in Figures 2-5.

Figure 3 shows a device that can communicate with a wearable device (read and write), controlled by the program on a PC or smartphone.

In the scheme of a stationary device presented in Figure 4 a computer or a smartphone powers the stationary deviceby the same connection by which the data are transferred.

Figure 5shows a scheme of a stationary device in which the necessary information is written down on it using the computer, and after that, everyone who touches the device will receive the data.

According to Figures2-5, the device comprises:

— Device case that incorporates all the electronics;
— MCU (microcontroller unit) –implements algorithms of data exchange, responsible for sending data and writing them to EEPROM (electrically erasable/programmable memory);
— EEPROM – stores received data and data that should be sent on contact(can be incorporated in MCU);
— Modulator – modulates the carrier frequency with the data to be sent;
— Demodulator – demodulates the input waveform and converts the modulated carrier frequency to the data bits;
— Driver circuit – drives the electrode with the modulated carrier frequency, generating the signal of the needed amplitude;
— Amplifier circuit – amplifies the input waveform(amplification can be combined with filtering, when only the specific frequency would

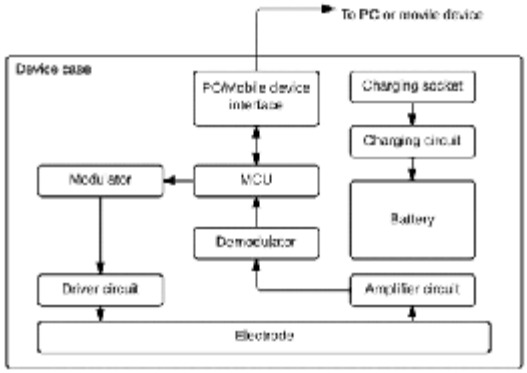

Fig. 3. Scheme of the device that connects to a personal computer (PC) or smartphone.

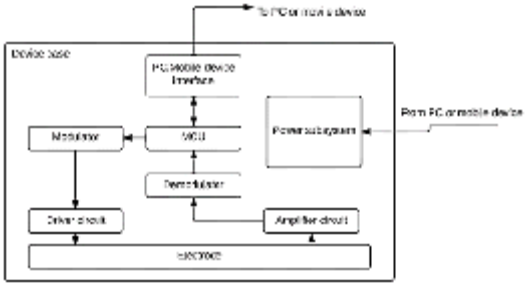

Fig. 4. Scheme of a stationary device (a).

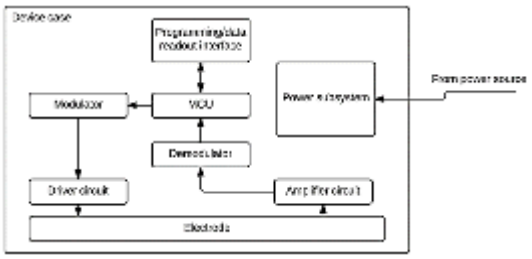

Fig. 5. Scheme of a stationary device (b).

be amplified);
- Battery – the autonomous power source, may be rechargeable, to power internal electronics;
- Charging socket – the socket to connect the external power to charge the device;
- Charging circuit – the circuit, responsible for generating the needed voltage and current, supplied with the power source, to charge the battery;
- Electrode;
- PC/mobile device interface;
- Power subsystem;
- Programming/data readout interface.

During operation, MCU wakes up several times per second on a short period of time (dozens of milliseconds) to activate a modulator to generate a waveform without any data, that, through a driver circuit goes on electrode, that, if near to a skin or touches it, transmits the signal to the human body. When another human with the same device touches the skin of the first one, this signal is passed to his electrode amplified with amplifier and demodulated with demodulator. Demodulator then wakes up the MCU and it starts to send continuously a waveform for a certain period of time that is longer, than the first device's pulse for it to be detected. This time the waveform carry the repeating code (like 010101... in binary form) to inform the first device its handshake pulse was received. After the first device finishes its pulse and MCU goes in sleep mode, demodulator receives the signal from amplifier from electrode and wakes up the MCU that sees the repeating code and knows the handshake was finished. After that, the first device's MCU waits for the repeating code to be finished and then starts transmitting the data. After first device's MCU stops transmitting the data, the second device's MCU records this data into EEPROM and transmits its data. The first device's MCU records them to EEPROM and both devices go into sleep-mode.

All electronic circuits are powered with the battery that can be charged with the charging circuit if a power plug is connected to the charging socket. All electronics is incorporated into the case.

As can be seen from the drawings, the converter device may comprise a power subsystem, so that instead of battery, the charging circuit and charging socket can be powered directly from PC or mobile device.

A converter device functions like a wearable device, except the data are not stored in the EEPROM, instead, they are transmitted to PC or mobile device via PC/Mobile interface, that can be USB, RS-232, RS-485, Bluetooth, etc.

An external device comprises device functions like the wearable device, but always has an external power source, its case is not wearable, but rather big with respect to wearable device, and its purpose is to be easily spotted. It can be used to store marketing materials, company contact information, etc.

CONCLUSION AND DISCUSSION

This paper provides a system for transition a relatively large amount of information via a human body allowing quick and secure exchange of business and other data. The work is underway to create the prototype of the system, to test and if required, modify it.

With the system, business and conference companies can get the most accuratestatistics of the attendees' activities and create additional revenueby advertising and matching services.The system will be useful for:
- Exhibition and conference companies;
- Exhibitors and people regularly visiting events;
- Meet up organizers, etc.

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