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Human Tap: A Unique Approach to Secure Data Transmission Synchronization

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Abstract: Human Tap introduces an avant-garde approach to secure data transmission synchronization, leveraging a harmonious integration of cutting-edge technologies. This unique method seamlessly incorporates Near Field Communication (NFC) and Human Field Communication (HFC) to deliver a range of secure communication solutions. The system's detailed specifications encompass crucial parameters such as maximum coverage range, frequency of operation, communication type, and data rate for each protocol. This tailoring enables the system to cater specifically to diverse applications, including but not limited to credit card payments, e-ticket booking, EZ-Pass, and item tracking. Noteworthy is Human Tap's proficiency in providing an exhaustive analysis of distance and time relationships, achieving an unprecedented microsecond-level accuracy for distances spanning up to 2 cm. This inventive synchronization method not only establishes a secure data transmission environment but also proves highly adaptable, effectively meeting the challenges posed by modern communication systems. In doing so, Human Tap sets a new standard for secure and versatile data transmission technologies.

Keywords: *Human body Chanel (HBC), Electro-Quasistatic Human Field Communication technology (EQ-HFC), Human Base Communication (HBC) Channel, Capacitive Coupling, and TX/RX Losses.*

1. Introduction

In the rapidly evolving landscape of information technology, the need for secure and efficient data transmission has become paramount. The conventional methods of encryption and synchronization have often proven effective, yet as technology advances, so too do the challenges in safeguarding sensitive information. Enter Human Tap, a groundbreaking approach to secure data transmission synchronization that bridges the gap between cutting-edge technology and human intuition. This innovative method harnesses the inherent ability of humans to recognize patterns and make split-second decisions, introducing a dynamic layer of security that goes beyond traditional algorithms. Human Tap represents a paradigm shift in data protection, combining the strengths of artificial intelligence with the unique cognitive capabilities of individuals to create a robust and adaptable solution.

The core concept of Human Tap revolves around the integration of human interaction into the data transmission synchronization process. By incorporating a tactile element, users become active participants in the authentication and encryption of data. This approach not only enhances security but also introduces an intuitive layer, allowing individuals to leverage their cognitive abilities in real-time. The synchronized tapping gestures serve as a dynamic cryptographic key, constantly evolving to adapt to the user's unique patterns and preferences. This fusion of technology and human intuition not only fortifies the data transmission process against cyber threats but also provides a user-friendly interface, empowering individuals to play a pivotal role in securing their digital communications.

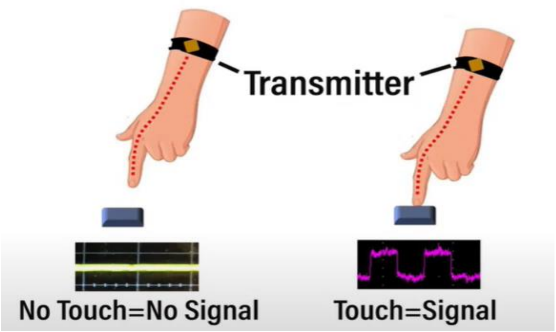

Fig 1. Human Data Communication [6]

As we delve deeper into the era of interconnected devices and digital communication, Human Tap emerges as a promising solution to the challenges posed by evolving cybersecurity threats. By embracing the fusion of human intuition and artificial intelligence, this unique approach not only fortifies data transmission synchronization but also offers a customizable and user-centric security solution. In this research paper, we will explore the underlying principles, implementation strategies, and potential applications of Human Tap in securing sensitive data, heralding a new era in the quest for robust, adaptable, and user-friendly cybersecurity measures.

The proposed HBC system aims to tackle these limitations

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by providing a secure and efficient method for transmitting data. By utilizing very low power and operating within a bandwidth of 14±2MHz, the system ensures that data can be transmitted over short distances, usually within 2cm, while prioritizing the safety of the human body involved.

2. Literature Study

Sarmad Nawzad Mahmoud et al. [1] have conducted a comprehensive presentation and analysis of all the various types of Ultra-Wideband (UWB) antennas and the systems they're used in, including those that are portable, stationary, and worn on the body. This article analyzes and compares various antenna designs, providing readers with insights into the factors that influence antenna performance. Wearable antenna design and emission modeling are both significantly complicated by the device's reliance on the human body. Before the antenna's potential output loss can be calculated when in use, the portable antenna's connection to the human body must be established in the earliest phases of design. Accordingly, the transmission channel of the Wireless Body Area Network (WBAN) is affected by the continual activity of the human body, leading to the time-varying propagation of electromagnetic waves.

Shitij Avlani et al. [2] have conducted a detailed analysis on high-impedance termination loss dominating at higher frequencies, whereas the 50-channel termination loss predominates at lower frequencies. At frequencies over 10MHz and 100MHz, the gap closes, coupling between devices vanishes, and it becomes very challenging to get a trustworthy measurement of channel loss in a single region of the human body. This is the first effort to use portable, battery-powered equipment to consistently quantify channel loss across 50 terminations in the high-impedance, capacitive HBC frequency range of 10 kHz to 1GHz. Lower channel loss is achieved with high-impedance termination (0dB at 1MHz) than with low-frequency 50 termination. As the frequency increases, the discrepancy narrows until it is almost equal at 80MHz. Above 100MHz, coupling between devices becomes dominant, preventing effective measurements of human loss.

Taewook Kang et al. [3] demonstrate how "HBC" provides a straightforward and low-cost method to increase signal range inside the human body without increasing overall power consumption. In the experiment, participants used portable, battery-powered devices to apply customized pulse impulses to various body parts. There are 52 distinct measurement states that are determined by the head-to-ankle and body position of the unit. Body channel transfer functions (BCTFs) were generated using an adaptive filter approach using an iterative algorithm to minimize the mean squared error between the observed and modeled impulse responses.

Shovan Maity, et al. [4], in their analysis of various safety regulations, note that limiting restrictions stem from the maximum field exposure, Specific Absorption Rate, and current density. Some design approaches may be utilized to guarantee "HBC" device safety compliance even in different human body situations when nominal specifications are not satisfied. It is the goal of this study to determine whether the current density and electric/magnetic fields produced by various "HBC" modalities meet current safety guidelines. Compliance of current density and fields with the established safety limits is quantified using circuit and "finite element method (FEM)" based simulations. Therefore, the pressure needed is many orders of magnitude less than the currents and fields of the capacitive "HBCs". Certain galvanic "HBC" excitation methods, however, may result in current densities and fields that are too high for safe human contact at the excitation point.

Visvesvaran.C et al. [5] present their superior invention, a technology renowned for its 10Mbps transmission speed and its limited range. The current invention is a body-centered electronic device user interface for personal computers and other system devices that depend on natural human behaviors. As the name implies, this invention is related to telecommunications and telecommunications, where connections are used for wire communication between stations and where information in wire connections must be recognized by links.

Juris Ormanis et al. [6] simulate the human body as poles with a known transmission function, making it possible to recreate the circuits and devices designed to enable communication via the body. The skin of a human being gives out essentially no frequencies below 10MHz. In the case of excessive current and voltage, this knowledge may be utilized to protect oneself.

Pitchakron Thippun et. al [7] have proven that packet delivery rate reduces as the packet size increases. The delivery rate of packets grows proportionally with the interval between their arrivals. Therefore, the delivery rate of a packet decreases as its size increases.

Mayukh Nath et al. [8] indicate that the amplitude of the "cloud-to-ground lightning (CG)" return route is near to the intrinsic capacity of the HBC ground plate if the HBC's size is modest in relation to its distance from the ground. Secure, low-power communication between handheld and wearable devices is made feasible by "HBC," which uses the human body as a conduction channel. Parasitic coupling of the device ground plane to the capacitive "HBC" environment creates the closed loop return channel while the body supplies the forward communication line.

Jianfeng Zhao et al. [9] discuss the origins and evolution of "HBC"; this study summarizes that work. The IEEE 802.15.6 standard defines "HBC" as a "non-radio frequency (RF)" short-range wireless communication system using the human body as the transmission medium. The fundamentals of HBC data transmission should be investigated thoroughly, in all its forms and aspects, experimental considerations included, theoretical models of signal propagation, channel characteristics, communication performance, and so on. The first part of this essay delves into HBC's infancy, examining its genesis and its first steps. After that, it gives a quick rundown of the various techniques used to send signals further. These models provide a concise description of key channel features.

Charmi Solanki et al. [10] discuss human network technologies that facilitate communication via human contact. It's becoming more important for mobile devices and environment-integrated terminals to be able to communicate with one another. Cables may get awkward and tangled when connecting devices that are near together. Data speeds may be slowed due to packet collisions in densely populated areas, such as stadiums, when weak wireless signals are utilized for communication. The security risk is heightened when one listens to unsolicited communications.

Drs. Ke Zhang, et al. [11] have proven that in wireless communications on and off the body, there is a thin 3-port broadband printed antenna. Radiation fields may be polarized along the x or y axis, and three gratings will excite three orthogonal patterns: one vertically polarized omnidirectional pattern and two horizontally polarized omnidirectional patterns. Pin patch antennas and a metal ring array of slots at the base produce vertical polarization modes, while the convergence of slot-modified E-shapes at the top produce’s horizontal polarization modes. They have developed a three-port "Multiple-Input Multiple-Output (MIMO)" antenna with a high-low bandwidth, various modes, and numerous polarizations for use in intra- and extra-corporeal communication. There is less than a tenth of a dB difference in the antenna's bandwidth, cross-coupling, radiation efficiency, and insertion loss, and the antenna's "error correction coefficient (ECC)" is less than 0.0001.

Bo Zhao et al. [13] predict that "digital "Body channel communication (BCC)" transceivers will become the standard soon. The introduction of digital power amplifiers has allowed for the digitization of physical quantities. Digital circuits based on an "analog-to-digital (ADC)" or a "time-to-digital (TDC)" converter may be used in the receiver. Flexible electronics use flexible, stretchy film substrates, allowing for conformal integration with the human body. Human vital signs may be monitored accurately and with little interference from daily activities thanks to the many sensors and communication ICs integrated into wearable flexible electronics. The high-power consumption of the radio is the design bottleneck in such a wearable flexible system, which also includes a sensor, a "front-end amplifier (FEA)," an "analog-to-digital converter (ADC)," a "microcontroller unit (MCU)," a radio, and a "power management unit (PMU)." "BCC" is an alternative to traditional wireless communication in which the surface of a human body is used as a signal transmission medium, leading to reduced signal loss and reduced power usage.

Swaminathan et al. [15] use a field programmable gate array for demodulation; the described instrument can reach a throughput of 8kbps FPGA. These attributes are prized in a liquid ionic environment because they are like the electrical characteristics of people. Our processes are quite similar. However, we no longer need to rely on human voices to translate network data. Promoting a project in this way saves money and improves the flexibility of potential changes. Additionally, we have used a third terminal to decrease the obstructions in regular mode. Then, we got to a point when the velocities of the two streams overlapped by around 2.3 Experiment with varying distances between the emitter and collector anodes, as far as 12 centimeters, to see how they interact with human tissues.

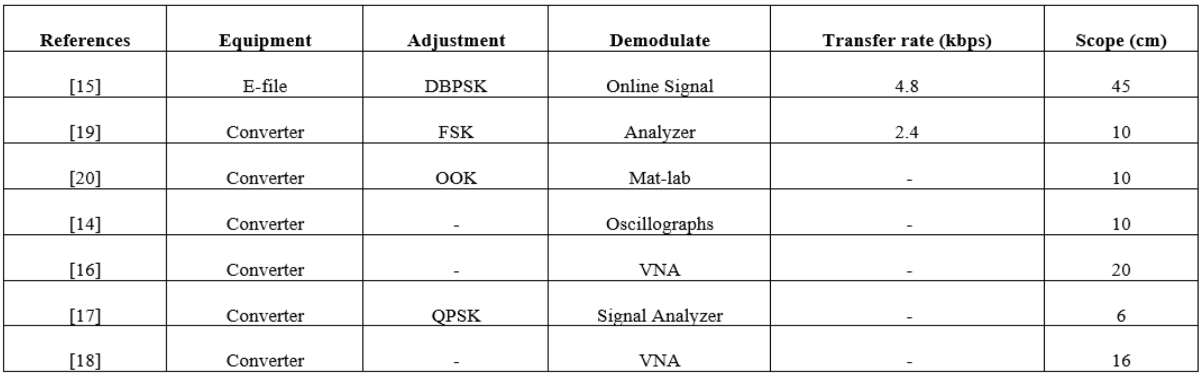
Tomlinson et al. [16] discuss the influence of the unadulterated conduction of ECG signals, a model circuit resembling a tissue channel of the human palmar arm has been devised. For one-way client authentication, this framework is necessary. The authors concur that the most effective use of cosmetically appealing implant frames and accessories is encouraged. To keep the error rate below 10^-6, it transmits data across 10cm, guaranteeing the steady functioning of the frame.

Channel search results for recent publications are shown in Table 2. The estimated data may be broken down into two categories: driver behavior [25, 28, 30] and crash characteristics [26, 27, 29]. Channel boundaries are calculated using delay factors such as mean delay, RMS delay spread, and reasonable performance studies by predicting the stimulus response. The human body's stride is decoded in the circuit model in [26] using tangential estimation of the distance between Tx and Rx and based on repetition, while the electric field conditions in the near and distant fields are discussed in [27].

Table 1. HBC's digital transmission methods

References	Methods of Transmit	Maximum data rate (Mbps)	Coupling Frequency (MHz)	Bandwidth (MHz)
[32]	Frequency Selective Digital Transmission	1.35	21	18.35–23.65
[33]	Parallelized multi-spreader	3.95	21	15.74–26.26
[34]	Parallelized multi-spreader	2.29	21	18.35–23.65
[35]	Multi-level baseband coding	60	80	NA
[36]	Direct Walsh code mapping	2	16	8–22
[37]	Direct spreading using FSC	1.35	21	20.345–21.625

Table 2. Work pertaining to human-body communication (HBC) based on galvanic.

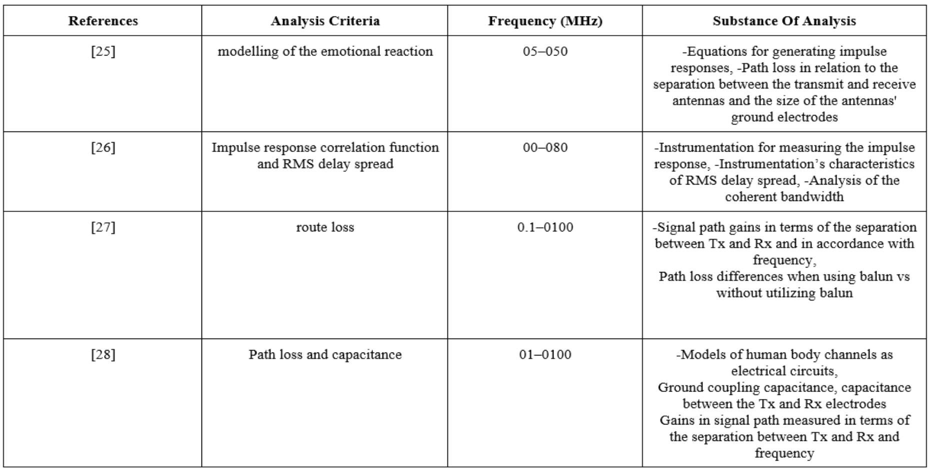


References	Equipment	Adjustment	Demodulate	Transfer rate (kbps)	Scope (cm)
[15]	E-file	DBPSK	Online Signal	4.8	45
[19]	Converter	FSK	Analyzer	2.4	10
[20]	Converter	OOK	Mat-lab	-	10
[14]	Converter	-	Oscillographs	-	10
[16]	Converter	-	VNA	-	20
[17]	Converter	QPSK	Signal Analyzer	-	6
[18]	Converter	-	VNA	-	16

In [31], the measuring setup and analysis of channel interference using measurement data are detailed. The "power spectral density (PSD)" of the effective interference source is calculated by first correcting the observed data using the equivalent circuit model of the input impedance of the human body. "Bit error rate (BER)" as a function of interference power is also shown.

New applications for "HBC" as a communication medium are investigated. Body fluids may be evaluated, and humoral illnesses like lymphedema can be diagnosed and treated with the use of galvanically linked "HBC" signals. Prosthetic control and gait analysis may benefit from joint angle estimates [1] based on a galvanic coupling system of human limbs. According to the data, there is a connection between exposure and "HBC" channels. For real-world use, disciplinary applications provide a hurdle to the development of plausible "HBC" systems. Additionally, "HBC" node monitoring data is unprocessed and unfiltered, making it difficult to aggregate the data for in-depth analysis. Moreover, it might be difficult to obtain trustworthy and user-friendly findings when gathering data from a wide variety of sensors (such as electrocardiogram and blood sensor devices)

Table 3. An overview of channel modelling



References	Analysis Criteria	Frequency (MHz)	Substance Of Analysis
[25]	modelling of the emotional reaction	05–050	-Equations for generating impulse responses, -Path loss in relation to the separation between the transmit and receive antennas and the size of the antennas' ground electrodes
[26]	Impulse response correlation function and RMS delay spread	00–080	-Instrumentation for measuring the impulse response, -Instrumentation's characteristics of RMS delay spread, -Analysis of the coherent bandwidth
[27]	route loss	0.1–0100	-Signal path gains in terms of the separation between Tx and Rx and in accordance with frequency, Path loss differences when using balun vs without utilizing balun
[28]	Path loss and capacitance	01–0100	-Models of human body channels as electrical circuits, Ground coupling capacitance, capacitance between the Tx and Rx electrodes Gains in signal path measured in terms of the separation between Tx and Rx and frequency

[29]	Impulse response characteristics of the path loss and time delay	05–080	-Modeling of the impulse response fitted with several random variables; -Path loss and delay features of the impulse responses based on the measured data from 70 human participants
[30]	Equation for the electric field and route loss	0.1–0100	-Using near-field and far-field equations to interpret the signal transmission process, -Using the collected data to validate theoretical route loss formulas, -Path loss measured in terms of the separation between the Tx and Rx and frequency
[31]	Path loss, the impulse response's time delay characteristics, and impulse response modelling	010–0100	Path loss based on frequency - Impulse response delay characteristics, including coherence bandwidth, mean delay, and RMS delay spread, based on data collected from measurements made on more than 90 human participants, -Aligning impulse response models

3. Methodology

3.1. Simulation Tools/Environments

MATLAB/Simulink: MATLAB/Simulink is widely used for modeling and simulating communication systems. It provides a comprehensive platform for designing and testing various communication scenarios, allowing for easy integration of human body models.

NS-3 (Network Simulator 3): NS-3 is an open-source network simulation tool that supports the simulation of communication protocols. It's particularly useful for studying wireless communication scenarios and can be adapted for simulating BANs.

CST Studio Suite: CST Studio Suite is commonly used for electromagnetic simulation. It can model the behavior of RF signals around the human body, providing insights into the effects of different frequencies and antenna placements.

In conclusion, simulation environments for Human Data Transmission Technology are indispensable for understanding the intricacies of communication links and channels within and around the human body. These tools contribute to the development of robust and efficient communication systems, ensuring reliability in real-world applications.

3.2. Capacitive Coupling

In 1995, Zimmerman [7] conducted a study on the Yo-Yo Ma bow of the cello and discovered that placing the hand in an electric field significantly attenuated the received signal. To utilize "HBC" for the transmission of digital information between electronic devices worn on or carried by a person, he proposed the concept of a "Personal Area Network (PAN)" based on these findings. Electrodes are employed to connect electrical impulses to the human body, which then acts as the medium through which the signals are transferred. To assess the feasibility of the HBC system, Zimmerman constructed a prototype. This proof-of-concept demonstrates that data transfer using "HBC" is indeed possible.

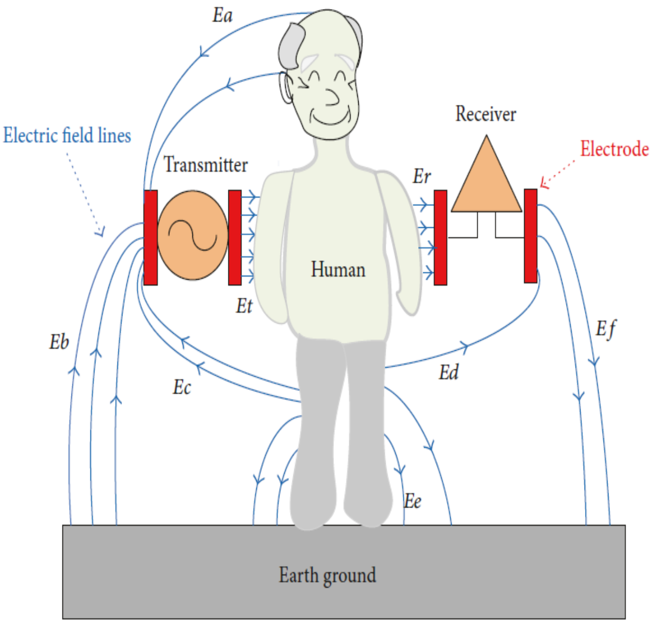


Fig 2. Capacitive Coupling[7]

Couplings that utilize capacitance are represented by "HBC" in Figure 1 and are referred to here as capacitive coupling [7]. The ground electrode is not attached to the skin and may float freely in the air, while the signal-sending and -receiving electrodes are placed on the skin. When a signal is sent from a transmitter, an electric field (Et) is produced and absorbed by the body via the electrodes. The human body acts as a conductive plate, generating electric fields (through Ea, Ec, and Ed) to other conductors, and it also links the electric field to the environment (via Eel, the ground electrode) plates, with the signal's return path formed by electric fields Ea, Ec, Ee-Eb, Er-Ef-Eb, and Ed-Ef-Eb. In other words, the return trip involves passing through the external electric field, often known as ground. The receiver can determine the relative magnitudes of Er, Ef, and Ed based on the difference in their potentials (the conductivity of the human body is much higher than that of air). Electric fields Ee, Ea, and Ec all leak energy; hence, the resulting potential difference is negligible. In addition, external influences, such as the ever-changing electric fields Ef and Ee, have a significant impact on the measured signal, making it unstable (for example, the presence of metal furniture, cables, water, and equipment will change the capacitance background).

Keeping the frequency of operation below 150MHz (2 dipole, 1 meter) will prevent the human body from serving as an antenna. In a transmitter, the electric field is highest at its tip. Capacitive "HBC" coupling is a promising technology for transmission lengths longer than the thickness of the body and/or higher operating frequencies (about 10,000MHz) (typically the entire length of the body). However, the "HBC" capacitive connection is less robust and is more likely to be disrupted by background noise or participants' unexpected movements.

Galvanic Coupling

Handa et al. [7] made the initial discovery of the "HBC" galvanic coupling in 1997. A microampere-level current is generated from the chest "ECG" signal, applied to the body through electrodes, and picked up by another set of electrodes. Because the transmitting and receiving electrodes are close to the body, the galvanically coupled signal can be sent from the wrist. The technology only requires 8 watts of electricity to function. Findings demonstrate that data transfer is possible with low transmission power using "HBC" galvanic coupling.

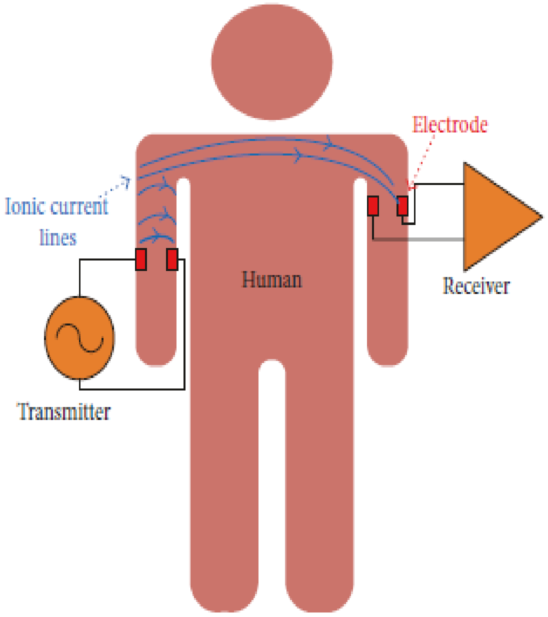


Fig 3. Galvanic Coupling[7]

In 1998, Lindsay et al. [7] investigated how implanted devices communicate with external data-collecting systems using "HBC" galvanic coupling. Two platinum electrodes (0.38mm in diameter and 2.5mm apart) were placed on the legs of human cadavers, and a sinusoidal current with a frequency of 2-160kHz and an amplitude of 1 was injected at a current density of 3mA. Electromyography electrodes were attached to the skin of the thigh to measure voltage fluctuations.

Attenuation on the human channel is 37 minus 7 decibels. By connecting implanted devices and surface sensors through HBC galvanic coupling, this prototype proves the concept. Electrical signals may be transmitted via the bulk conduction qualities of ionic fluids and human tissues using "HBC" electrical coupling, commonly known as "HBC" waveguides. A reduced schematic of the model is shown in Figure 3. Tissues near the emitter develop a substantial ionic current. The current decreases with distance from the emitter to the receiver due to the resistance of biological tissues. The small current in the receiver may be picked up by the high-gain differential amplifier.

Already existing testing and prototypes often include human limbs. Since the idea of signal transmission relies on ion currents, the operating frequency must be low (that is, less than 1 MHz). Radiation or signal leakage into space is modest at these low frequencies.

The HBC current coupler is more stable and dependable in signal transmission and has a lower operating frequency than the HBC capacitive coupler. Therefore, vital physiological signals, particularly those requiring interaction with implanted devices, are better transmitted through "HBC" galvanic coupling. Of course, your expected data transfer rates will suffer as a result. Fortunately, the transmission rates needed to provide vital physiological signals are quite low, ranging from 75kbps for "electrocardiograms (ECGs)" to 1.6kbps for oxygen saturation levels (SpO2) to 100kbps for pacemakers and implanted glucose sensors. Therefore, vital physiological data may be transferred between implanted and open devices through "HBC" galvanic coupling.

4. Proposed System

The human body functions much like an electrical circuit, exhibiting both resistance and capacitance. During data transfer, a signal traverses through the human body, acting as a capacitor that effectively stores charge. In the transmission phase, when data is dispatched—such as by placing one hand on the copper-insulated transmitter touchpad—the charge circulates within the body and is subsequently captured on the receiver touchpad at the opposing end. The transmission of data involves capacitive coupling between the transmitter and receiver through the body. Owing to the signal's low frequency during transmission and the inherent resistance of the body, signal attenuation occurs, necessitating the incorporation of an LM-358 amplifier at the receiver to mitigate this effect. Overseeing the entire transmission and reception process is the Microcontroller IC, which manages data transfer by adjusting the received signal to a pre-defined threshold voltage level. The successful reception of data is visually indicated by the LED's blinking, confirming the accomplishment of the data transfer process.

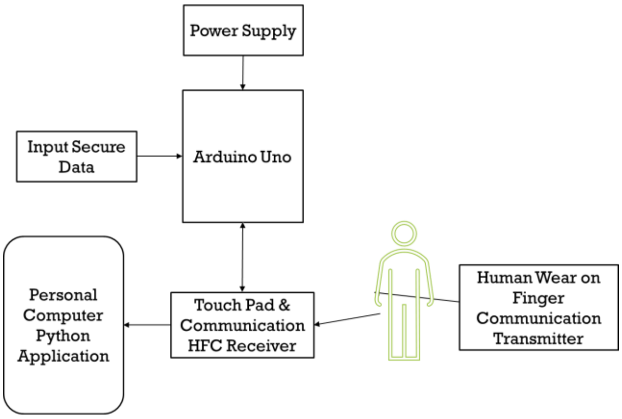


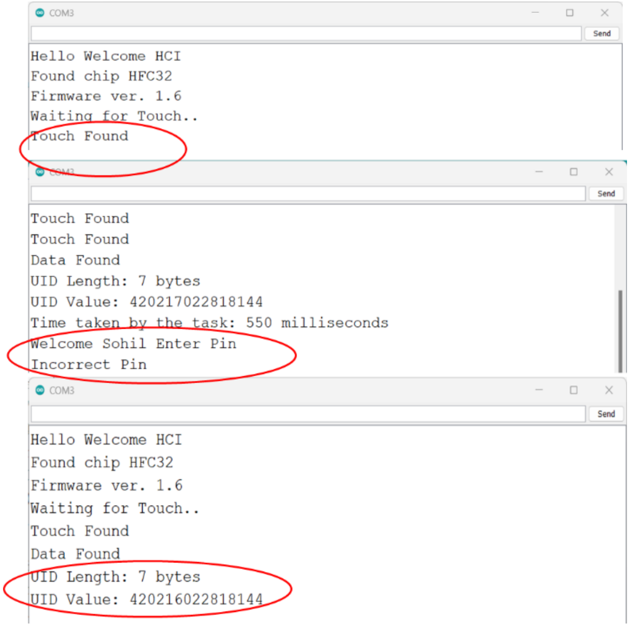
Fig 4. Proposed System Block Diagram

In the absence of direct touch, this technology refrains from transmitting any data, enhancing the privacy features of this wristband device. Essentially, this means that unless there is physical contact, data transmission does not occur, effectively safeguarding against potential security breaches. Even the slightest proximity of a finger above the surface does not trigger data transmission, thus thwarting attempts by hackers to intercept signals and access personal information.

In experiments conducted, when a finger made direct contact with an electrode, only the corresponding surface's light illuminated, while the lights on other surfaces remained inactive. This observation signifies that no data leakage occurred, affirming the robustness of the privacy measures implemented by the technology.

5. Result Analysis

Fig 5. Physical Model

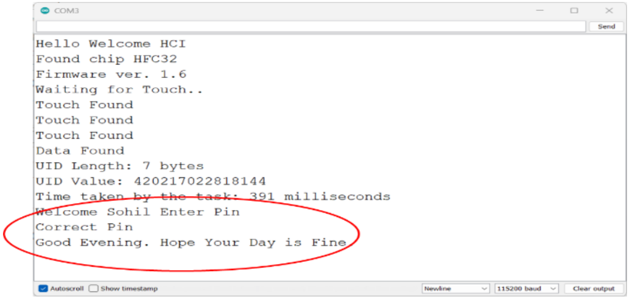


```
Hello Welcome HCI
Found chip HFC32
Firmware ver. 1.6
Waiting for Touch..
Touch Found
```

```
Touch Found
Touch Found
Data Found
UID Length: 7 bytes
UID Value: 420217022818144
Time taken by the task: 550 milliseconds
Welcome Sohil Enter Pin
Incorrect Pin
```

```
Hello Welcome HCI
Found chip HFC32
Firmware ver. 1.6
Waiting for Touch..
Touch Found
Data Found
UID Length: 7 bytes
UID Value: 420216022818144
```

Fig 6. Terminal Output



```
Hello Welcome HCI
Found chip HFC32
Firmware ver. 1.6
Waiting for Touch..
Touch Found
Touch Found
Touch Found
Data Found
UID Length: 7 bytes
UID Value: 420217022818144
Time taken by the task: 391 milliseconds
Welcome Sohil Enter Pin
Correct Pin
Good Evening. Hope Your Day is Fine
```

Fig 6. Msg Transmitted When Authentication Done

Table 4. Comparative parameters

Specification	NFC	RFD	Bluetooth	HFC
Maximum Coverage Range	10 cm	3meter	100meter	2 Cm
Frequency of operation	13.56MHz	varies	2.4GHz	12-16 MHz
Communication	2-way	1 -way	2-way	2-way
Data rate	106,212,424Kbps	varies	22Mbps	7-bytes
Applications	credit card related payments, e-ticket booking	EZ-Pass, tracking items	communication between phone and peripherals	credit card, Security Login, Voting System

Table 5. Distance VS Time

Distance	Time
0.10 cm	24 microseconds
0.20 cm	26 microseconds
0.30 cm	28 microseconds
0.40 cm	32 microseconds
0.50 cm	36 microseconds
1 cm	38 microseconds
2 cm	42 microseconds

6. Conclusion

The Human Tap system presents a novel approach to secure data transmission synchronization, integrating Near Field Communication (NFC), Radio-Frequency Identification (RFID), Bluetooth, and Human Field Communication (HFC) technologies. This innovative system offers distinct specifications for each communication protocol, including maximum coverage range, frequency of operation, communication type, and data rate. NFC, with a coverage range of 10 cm and a frequency of 13.56MHz, is tailored for credit card-related payments and e-ticket booking. RFID, operating at a range of 3 meters, finds applications in EZ-Pass and item tracking. Bluetooth, with an impressive 100-meter range and 2.4GHz frequency, facilitates two-way communication between phones and peripherals. HFC, optimized for a 2 cm range and 12-16 MHz frequency, serves purposes such as credit card transactions, security login, and voting systems. Additionally, the system provides a comprehensive analysis of distance and time relationships for precise synchronization, offering microsecond-level accuracy for varying distances up to 2 cm. This multifaceted approach to data transmission synchronization enables a diverse range of secure applications in the realm of modern communication systems.

7. References and Footnotes

Author contributions

Conceptualization—Sohil Shah and Harshal Shah; Methodology— Sohil Shah; Software— Sohil Shah; Validation—Dr. Harshal Shah; Formal Analysis— Sohil Shah and Dr. Harshal Shah; Investigation—Dr. Harshal Shah; Resources— Sohil Shah; data curation— Sohil Shah; Writing—review and editing— Sohil Shah and Dr. Harshal Shah; Visualization— Sohil Shah; supervision—Dr. Harshal Shah; Project administration— Sohil Shah.

Conflicts of interest

The authors declare no conflicts of interest.

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