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TECHNICAL NOTE

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The Biochip Technology Implementation and Major Advances in Medical Applications

Mr. Chaithanya Kadari*
09D41D5803, M.Tech CSE
Department of Computer Science and Engineering
Sri Indu College of Engineering and Technology
Sheriguda, Ibrahimpatnam, Ranga Reddy Dist,
Andhra Pradesh, India-501510
chaithu.555@gmail.com

Dr. Ch GVN Prasad
Professor,
Department of Computer Science and Engineering
Sri Indu College of Engineering and Technology
Sheriguda, Ibrahimpatnam, Ranga Reddy Dist, Andhra Pradesh, India-501510
prasadch204@gmail.com

Miss. Padma Koutarapu
09D41D0501, M.Tech CS
Department of Computer Science and Engineering
Sri Indu College of Engineering and Technology
Sheriguda, Ibrahimpatnam, Ranga Reddy Dist, Andhra Pradesh, India-501510
k_padmavathi_cs@yahoo.co.in

Mr. Saidulu Yelagandula
09D41D0505, M.Tech CS
Department of Computer Science and Engineering
Sri Indu College of Engineering and Technology
Sheriguda, Ibrahimpatnam, Ranga Reddy Dist,
Andhra Pradesh, India-501510
saidulu505@gmail.com

Abstract: "Biochips"-The most exciting future technology is an outcome of the fields of Computer science, Electronics & Biology. Its a new type of bio-security device to accurately track information regarding what a person is doing, and who is to accurately track information regarding what he is doing, and who is actually doing it. It's no more required with biochips the good old idea of remembering pesky PINs, Passwords, & Social security numbers (SSN) .No more matters of carrying medical records to a hospital, No more cash/credit card carrying to the market place. Biochip has a variety technique for secured E-money transactions on the net. The power of biochips exists in capability of locating lost children, downed soldiers, and wandering Alzheimer patients. The chips are of the size of an uncooked grain of rice, small enough to be injected under the skin using a hypodermic syringe needle. They respond to a signal from the detector, held just a few feet away, by transmitting out an identification number. This number is then compared to database listings of registered pets. The Biochip tagging for humans has already started…Rush out for your tag!!!!!

Keywords: Biochip, Bio-security device, SSN, Hypodermic syringe

I. INTRODUCTION

A biochip is a collection of miniaturized test sites (micro arrays) arranged on a solid substrate that permits many tests to be performed at the same time in order to achieve higher throughput and speed. Typically, a biochip's surface area is no larger than a fingernail. Like a computer chip that can perform millions of mathematical operations in one second, a biochip can perform thousands of biological reactions, such as decoding genes, in a few seconds. Biochips are any microprocessor chips that can be used in Biology. The biochip technology was originally developed in 1983 for monitoring fisheries, it's use now includes, over 300 zoos, over 80 government agencies in at least 20 countries, pets (everything from lizards to dogs), electronic "branding" of horses, monitoring lab animals, fisheries, endangered wildlife, automobiles, garment tracking, hazardous waste, and humans. Biochips are "silently" inching into humans. For instance, at least six million medical devices, such as artificial body parts (prosthetic devices), breast implants, chin implants, etc., and are implanted in people each year. And most of these medical devices are carrying a "surprise" guest — a biochip. In 1993, the Food and Drug Administration passed the Safe Medical Devices Registration Act of 1993, requiring all artificial body implants to have "implanted" identification — the biochip. So, the yearly, 6 million recipients of prosthetic devices and breast implants are "biochipped". To date, over seven million animals have been "chipped". The major biochip companies are A.V.I.D. (American Veterinary Identification Devices), Trovan Identification Systems, and Destron-Fearing Corporation [1] [2] [3] [4].

II. THE BIOCHIP TECHNOLOGY

The current, in use, biochip implant system is actually a fairly simple device. Today's, biochip implant is basically a small (micro) computer chip, inserted under the skin, for identification purposes. The biochip system is radio frequency identification (RFID) system [7], using low-frequency radio signals to communicate between the biochip and reader. The reading range or activation range, between reader and biochip is small, normally between 2 and 12 inches [5] [6].

A. Size

The size of Biochip is of a size of an uncooked rice grain size. It ranges from 2inches to 12inches.

Figure.1. Size of Biochip

B. Components of the Biochip

The biochip implant system consists of mainly two components the transponder and reader [7].

[a] The Transponder

The transponder is the actual biochip implant. It is a passive transponder, meaning it contains no battery or energy of its own. In comparison, an active transponder would provide its own energy source, normally a small battery. Because the passive biochip contains no battery, or nothing to wear out, it has a very long life, up to 99 years, and no maintenance. Being passive, it's inactive until the reader activates it by sending it a low-power electrical charge. The reader "reads" or "scans" the implanted biochip and receives back data (in this case an identification number) from the biochip. The communication between biochip and reader is via low-frequency radio waves.

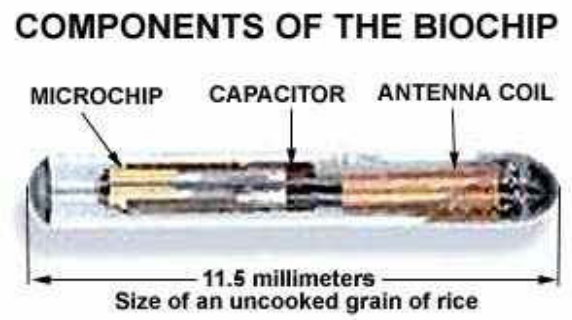

Figure.2. Transponder

The biochip transponder consists of four parts:

(i) Computer Microchip:

The microchip stores a unique identification number from 10 to 15 digits long. The storage capacity of the current microchips is limited, capable of storing only a single ID number. AVID (American Veterinary Identification Devices), claims their chips, using an nnn-nnn-nnn format, has the capability of over 70 trillion unique numbers. The unique ID number is "etched" or encoded via a laser onto the surface of the microchip before assembly. Once the number is encoded it is impossible to alter. The microchip also contains the electronic circuitry necessary to transmit the ID number to the "reader".

(ii) Antenna Coil:

This is normally a simple, coil of copper wire around a ferrite or iron core. This tiny, primitive, radio antenna "receives and sends" signals from the reader or scanner.

(iii) Tuning Capacitor:

The capacitor stores the small electrical charge (less than 1/1000 of a watt) sent by the reader or scanner, which activates the transponder. This "activation" allows the transponder to send back the ID number encoded in the computer chip. Because "radio waves" are utilized to communicate between the transponder and reader, the capacitor is "tuned" to the same frequency as the reader.

(iv) Glass Capsule:

The glass capsule "houses" the microchip, antenna coil and capacitor. It is a small capsule, the smallest measuring 11 mm in length and 2 mm in diameter, about the size of an uncooked grain of rice. The capsule is made of biocompatible material such as soda lime glass. After assembly, the capsule is hermetically (air-tight) sealed, so no bodily fluids can touch the electronics inside. Because the glass is very smooth and susceptible to movement, a material such as a polypropylene polymer sheath is attached to one end of the capsule. This sheath provides a compatible surface, which the bodily tissue fibers bond or interconnect, resulting in a permanent placement of the biochip.

The biochip is inserted into the subject with a hypodermic syringe. Injection is safe and simple, comparable to common vaccines. Anesthesia is not required nor recommended. In dogs and cats, the biochip is usually injected behind the neck between the shoulder blades. Trovan, Ltd., markets an implant, featuring a patented "zip quill", which you simply press in, no syringe is needed. According to AVID "Once implanted, the identity tag is virtually impossible to retrieve . . . The number can never be altered."

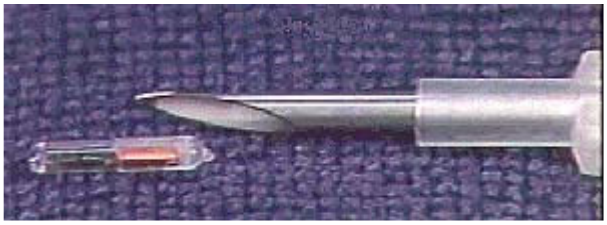

Figure.3.Hypodermic syringe

[b] *The reader*

The reader consists of an "exciter" coil which creates an electromagnetic field that, via radio signals, provides the necessary energy (less than 1/1000 of a watt) to "excite" or "activate" the implanted biochip. The reader also carries a receiving coil that receives the transmitted code or ID number sent back from the "activated" implanted biochip. This all takes place very fast, in milliseconds. The reader also contains the software and components to decode the received code and display the result in an LCD display. The reader can include a RS-232 port to attach a computer [7].

Figure.4. Reader

III. WORKING OF A BIOCHIP

The reader generates a low-power, electromagnetic field, in this case via radio signals, which "activates" the implanted biochip. This "activation" enables the biochip to send the ID code back to the reader via radio signals. The reader amplifies the received code, converts it to digital format, decodes and displays the ID number on the reader's LCD display. The reader must normally be between 2 and 12 inches near the biochip to communicate. The reader and biochip can communicate through most materials, except metal [2].

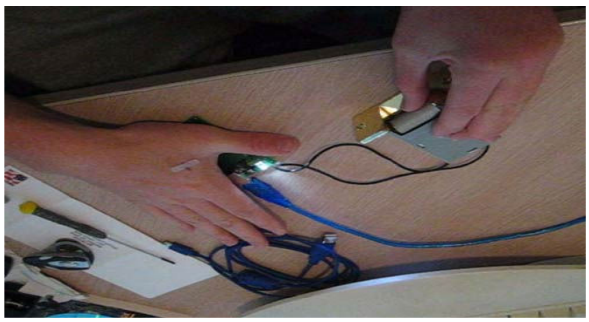

Figure.5. Working of a Biochip

IV. THE APPLICATIONS OF A BIOCHIP

A. With a biochip tracing of a person/animal, anywhere in the world is possible:
Once the reader is connected to the Internet, satellite and a centralized database is maintained about the biochipped creatures, it is always possible to trace out the personality intended [8].

B. A biochip can store and update financial, medical, demographic data, basically everything about a person:
An implanted biochip can be scanned to pay for groceries, obtain medical procedures, and conduct financial transactions. Currently, the in use, implanted biochips only store one 10 to 15 digits. If biochips are designed to accommodate with more ROM & RAM there is definitely an opportunity [8].

C. A biochip leads to a secured E-Commerce systems:
It's a fact; the world is very quickly going to a digital or E-economy, through the Internet. It is expected that by 2012, 60% of the Business transactions will be performed through the Internet. The E-money future, however, isn't necessarily secure. The Internet wasn't built to be Fort Knox. In the wrong hands, this powerful tool can turn dangerous. Hackers have already broken into bank files that were 100% secure. A biochip is the possible solution to the "identification and security" dilemma faced by the digital economy. This type of new bio-security device is capable of accurately tracking information regarding what users are doing, and who are to accurately track information regarding what users are doing, and who is actually doing it [8].

V. MEDICINAL IMPLEMENTATIONS OF BIOCHIPS

A. New Era Proposed by us

[a] Biochip as Glucose Detector

The Biochip can be integrated with a glucose detector. The chip will allow diabetics to easily monitor the level of the sugar glucose in their blood. Diabetics currently use a skin prick and a hand-held blood test, and then medicate themselves with insulin depending on the result. The system is simple and works well, but the need to draw blood means that most diabetics don't test themselves as often as they should. Although they may get away with this in the short term, in later life those who monitored infrequently suffer from blindness, loss of circulation, and other complications. The solution is more frequent testing, using a less invasive method. The biochip will sit underneath the skin, sense the glucose level, and send the result back out by radio-frequency communication.

[i] Proposed Principle of Glucose Detection:

A light-emitting diode (LED) in the biochip starts off the detection process. The light that it produces hits a fluorescent chemical: one that absorbs incoming light and re-emits it at a longer wavelength. The longer wavelength of light is then detected, and the result is sent to a control panel outside the body. Glucose is detected because the sugar reduces the amount of light that the fluorescent chemical re-emits. The more glucose there is the less light that is detected.

B. Biochip as Oxygen sensor

The biochip can also be integrated with an oxygen sensor .The oxygen sensor will be useful not only to monitor breathing in intensive care units, but also to check that packages of food, or containers of semiconductors stored under nitrogen gas, remain airtight.

[i] Proposed Principal of Oxygen Sensor in Biochip:

The oxygen-sensing chip sends light pulses out into the body. The light is absorbed to varying extents, depending on how much oxygen is being carried in the blood, and the chip detects the light that is left. The rushes of blood pumped by the heart are also detected, so the same chip is a pulse monitor.

C. Biochip as a Blood Pressure sensor

In normal situations, The Blood Pressure of a healthy Human being is 120/80 mm of Hg. A Pressure ratio lower than this is said to be "Low BP " condition & A Pressure ratio more than this is "High BP" condition. Serious Effects will be reflected in humans during Low & High BP conditions; it may sometimes cause the death of a Person. Blood Pressure is checked with BP Apparatus in Hospitals and this is done only when the patient is abnormal. However, a continuous monitoring of BP is required in the aged people & Patients.

[i] Proposed Principal of Blood Pressure Sensor in Biochip:

A huge variety of hardware circuitry (sensors) is available in electronics to detect the flow of fluid. It's always possible to embed this type of sensors into a biochip. An integration of Pressure (Blood Flow) detecting circuits with the Biochip can make the chip to continuously monitor

the blood flow rate & when the pressure is in its low or high extremes it can be immediately informed through the reader hence to take up remedial measures.

VI. TYPICAL PROBLEM OF BIOCHIPS

A. A Solution Proposed –

[a] The Lock: Problem before the world

A chip implant would contain a person's financial world, medical history, health care — it would contain his electronic life". If cash no longer existed and if the world's economy was totally chip oriented; — there would be a huge "black-market" for chips! Since there is no cash and no other bartering system, criminals would cut off hands and heads, stealing "rich-folks" chips.

"It is very dangerous because once kidnappers get to know about these chips, they will skin people to find them," (New York Times, June 20, 1999)

The typical solutions won't work well are already proposed by different people:

The Biochip must retain data only if it is placed in a fluid medium like blood & not in any other medium.

This technique is unsuitable for identification of dead bodies (murdered by the kidnappers) as it loses the data about the social security number.

The data in the Biochip must be erased if it is exposed to sunlight/air.

This technique is unsuitable as transplantation of biochip from genuine to the fraud in darkness (by means of infrared light) or in the vacuum (by means of oxygen cylinders).

And many such…….!!!!!!!!

[b] Our key: The solution Proposed by us

A generic & existing model of Biochips consists of only ROM component in it and is capable of accommodating the data such as social security number, Passport number, bankcard number etc., which are normally permanent in nature. The induction of RAM component in addition to ROM & storing the Bankcard, Financial details which causes the problem is a mere solution.

As RAM needs to be continuously charged inorder to retain the data, Current can be supplied to the chip either from the electrical energy produced in the cells or by converting the heat energy in our body to electrical energy.

Once if the chip is taken out from the human body RAM immediately loses the Power supply from the human body; thus information in the RAM is lost and therefore is useless for the kidnappers.

However this technique will not affect the data in ROM i.e. Social security number that can be used to detect the address of the dead bodies that were unidentified.

VII. CONCLUSION

A chip implanted somewhere in human bodies might serve as a combination of credit card, passport, driver's license, personal diary. No longer would it be needed to worry about losing the credit cards while traveling. A chip inserted into human bodies might also give us extra mental power.

The really fascinating idea is under fast track research "but we're close." The day in which we have chips embedded in our skins is not too far from now. "This is science fiction stuff." ,"This is a true example to prove science really starts with fiction".

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