RISE-MAGAZINE

Recent Innovations In Sophisticated Electronics

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VOLUME 12 JAN-JUN 2018

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INTERNET OF THINGS

What Is The Internet of Things (IoT)

The Internet of Things may be a hot topic in the industry but it's not a new concept. In the early 2000's, Kevin Ashton was laying the groundwork for what would become the Internet of Things (IoT) at MIT's AutoID lab. Ashton was one of the pioneers who conceived this notion as he searched for ways that Proctor & Gamble could improve its business by linking RFID information to the Internet. The concept was simple but powerful. If all objects in daily life were equipped with identifiers and wireless connectivity, these objects could be communicate with each other and be managed by computers.

In a 1999 article for the RFID Journal Ashton wrote: "If we had computers that knew everything there was to know about things—using data they gathered without any help from us -- we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory. RFID and sensor technology enable computers to observe, identify and understand the world—without the limitations of human-entered data."1 At the time, this vision required major technology improvements. After all, how would we connect everything on the planet? What type of wireless communications could be built into devices? What changes would need to be made to the existing Internet infrastructure to support billions of new devices communicating? What would power these devices? What must be developed to make the solutions cost effective? There were more questions than answers to the IoT concepts in 1999. Today, many of these obstacles have been solved. The size and cost of wireless radios has dropped tremendously. IPv6 allows us to assign a communications address to billions of devices. Electronics companies are building Wi-Fi and cellular wireless connectivity into a wide range of devices. ABI Research estimates over five billion wireless chips will ship in 2013.2 Mobile data coverage has improved significantly with many networks offering broadband speeds. While not perfect, battery technology has improved and solar recharging has been built into numerous devices. There will be billions of objects connecting to the network with the next several years. For example,Cisco's Internet of Things Group (IOTG) predicts there will be over 50 billion connected devices by 2020

IoT describes a system where items in the physical world, and sensors within or attached to these items, are connected to the Internet via wireless and wired Internet connections. These sensors can use various types of local area connections such as RFID, NFC, Wi-Fi, Bluetooth, and Zigbee. Sensors can also have wide area connectivity such as GSM, GPRS, 3G, and LTE. The Internet of Things will:

Connect both inanimate and living things. Early trials and deployments of Internet of Things networks began with connecting industrialequipment. Today, the vision of IoT has expanded to connect everything from industrial equipment to everyday objects. The types of items range from gas turbines to automobiles to utility meters. It can also include living organisms such as plants, farm animals and people. For example, the Cow Tracking Project in Essex uses data collected from radio positioning tags to monitor cows for illness and track behavior in the herd. Wearable computing and digital health devices, such as Nike+ Fuel band and Fitbit, are examples of how people are connecting in the Internet of Things landscape. Cisco has expanded the definition of IoT to the Internet of Everything (IoE), which includes people, places, objects and things. Basically anything you can attach a sensor and connectivity to can participate in the new connected ecosystems.

Use sensors for data collection. The physical objects that are being connected will possess one or more sensors. Each sensor will monitor a specific condition such as location, vibration, motion and temperature

- Change what types of item communicate over an IP Network. In the past, people communicated with people and with machines. Imagine if all of your equipment had the ability to communicate. What would it tell you? IoT-enabled objects will share information about their condition and the surrounding environment with people, software systems and other machines. This information can be shared in realtime or collected and shared at defined intervals. Going forward, everything will have a digital identity and connectivity, which means you can identify, track and communicate with objects.
- What It Means For Your Business? IoT impacts every business. Mobile and the Internet of Things will change the types of devices that connect into a company's systems. These newly connected devices will produce new types of data. The Internet of Things will help a business gain efficiencies, harness intelligence from a wide range of equipment, improve operations and increase customer satisfaction. IoT will also have a profound impact on people's lives. It will improve public safety, transportation and healthcare with better information and faster communications of this information. While there are many ways that the Internet of Things could impact society and business, there are at least three major benefits of IOT that will impact every business, which include: communication, control and cost savings.
- The Three Cs of IoT

Communication. IoT communicates information to people and systems, such as state and health of equipment (e.g.it's on or off, charged, full or empty) and data from sensors that can monitor a person's vital signs. In most cases, we didn't have access to this information before or it was collected manually and infrequently. For example, an IOT-enabled HVAC system can report if its air filter is clean and functioning properly. Almost every company has a class of assets it could track. GPS-enabled assets can communicate their current location and movement. Location is important for items that move, such as trucks, but it's also applicable for locating items and people within an organization. In the healthcare industry, IoT can help a hospital track the location of everything from wheelchairs to cardiac defibrillators to surgeons. In the transportation industry, a business can deliver real-time tracking and condition of parcels and pallets. For example, Maersk can use sensors to track the location of a refrigerated shipping container and its current temperature. Control and Automation. In a connected world, a business will have visibility into a device's condition. In many cases, a business or consumer will also be able to remotely control a device. For example, a business can remotely turn on or shut down a specific piece of equipment or adjust the temperature in a climate-controlled environment. Meanwhile, a consumer can use IoT to unlock their car or start the washing machine. Once a performance baseline has been established, a process can send alerts for anomalies and possibly deliver an automated response. For example, if the brake pads on a truck are about to fail, it can prompt the company to take the vehicle out of service and automatically schedule maintenance.

Cost Savings. Many companies will adopt IoT to save money. Measurement provides actual performance data and equipment health, instead of just estimates. Businesses, particularly industrial companies, lose money when equipment fails. With new sensor information, IoT can help a company save money by minimizing equipment failure and allowing the business to perform planned maintenance. Sensors can also measuring items, such as driving behavior and speed, to reduce fuel expense and wear and tear on consumables. New smart meters in homes and businesses can also provide data that helps people understand energy consumption and opportunities for cost savings.

How To Get Started

These are just a few examples of how IoT can help a business save money, automate processes and gain new insight into the business. To reap the benefits IoT can provide, a business should address at least the following four items:

1. Define what you'd like to learn from sensors. Over the next three years, a majority of the devices purchased will have sensors and many existing items can be retrofitted with sensors. This will produce a wide range of new data sources for people and systems to use to improve their lives and existing business processes. Within a business setting, IT must define what types of information can be obtained from these sensors and work with business leaders to define which business processes can be improved with this new IoT information. For example, sensor data that highlights anomalies in equipment vibration can be used to predict and avoid equipment failure.
2. Build an IOT network and security foundation. Many industrial IoT deployments have used proprietary networks. Instead of building proprietary networks, IT should connect IoT devices with standards-based IP networks. An IP-based network will help businesses deliver the performance, reliability and interoperability that are required to support global IoT networks and connections with partner ecosystems. smartphones and tablets, but this is just one aspect of the new mobile world. The proliferation of connected sensors and equipment provides new security concerns. As IT embraces IoT, it needs to ensure it has built safeguards into the solution including security procedures such as hardware encryption, physical building security and network security for data in transit. Identity and authentication structures will also need to be updated to support "things" as well as people.

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3. Collect as much data as possible.

Businesses that don't plan carefully for IoT will be overwhelmed with the volume and variety of data that IoT will generate. While each sensor may only produce a small amount of data, a company will be collecting data from thousands to millions of sensors. Firms must build a data collection and analytics strategy that supports this new torrent of information in a scalable and cost effective manner. Big data technology, such as Hadoop and NoSQL, can give companies the ability to rapidly collect, store and analyze large volumes of disparate IoT data. A company should collect any data that is relevant to existing processes. If possible and cost -effective, a company should also collect additional data that will enable the business to answer new questions in the future.

4. Review the size and scale of IoT providers.

IoT is a complicated landscape with numerous categories and many vendors within each category. The four main categories of an IoT solution are: a sensor(s) and radio(s) that often sits in the machine, a M2M device-management platform, a solution delivery platform and apps that enable IoT devices to report or act on data. While there are many vendors, no single vendor offers a complete solution without building partnerships. As a firm begins its IoT voyage, IT and line of business executives should build a cross-functional team to evaluate strategic partners. The team should evaluate the financial position of the vendors, industry knowledge, partnerships and breadth of offerings.

1. Smart home

Smart Home clearly stands out, ranking as highest Internet of Things application on all measured channels. More than 60,000 people currently search for the term "Smart Home" each month. This is not a surprise. The IoT Analytics company database for Smart Home includes 256 companies and startups. More companies are active in smart home than any other application in the field of IoT. The total amount of funding for Smart Home startups currently exceeds $2.5bn. This list includes prominent startup names such as Nest or AlertMe as well as a number of multinational corporations like Philips, Haier, or Belkin.

2. Wearables

Wearables remains a hot topic too. As consumers await the release of Apple's new smart watch in April 2015, there are plenty of other wearable innovations to be excited about: like the Sony Smart B Trainer, the Myo gesture control, or LookSee bracelet. Of all the IoT startups, wearables maker Jawbone is probably the one with the biggest funding to date. It stands at more than half a billion dollars!

3. Smart City

Smart city spans a wide variety of use cases, from traffic management to water distribution, to waste management, urban security and environmental monitoring. Its popularity is fueled by the fact that many Smart City solutions promise to alleviate real pains of people living in cities these days. IoT solutions in the area of Smart City solve traffic congestion problems, reduce noise and pollution and help make cities safer.

4. Smart grids

Smart grids is a special one. A future smart grid promises to use information about the behaviors of electricity suppliers and consumers in an automated fashion to improve the efficiency, reliability, and economics of electricity. 41,000 monthly Google searches highlights the concept's popularity. However, the lack of tweets (Just 100 per month) shows that people don't have much to say about it.

5. Industrial internet

The industrial internet is also one of the special Internet of Things applications. While many market researches such as Gartner or Cisco see the industrial internet as the IoT concept with the highest overall potential, its popularity currently doesn't reach the masses like smart home or wearables do. The industrial internet however has a lot going for it. The industrial internet gets the biggest push of people on Twitter (~1,700 tweets per month) compared to other non-consumer-oriented IoT concepts.

6. Connected car

The connected car is coming up slowly. Owing to the fact that the development cycles in the automotive industry typically take 2-4 years, we haven't seen much buzz around the connected car yet. But it seems we are getting there. Most large auto makers as well as some brave startups are working on connected car solutions. And if the BMWs and Fords of this world don't present the next generation internet connected car soon, other well-known giants will: Google, Microsoft, and Apple have all announced connected car platforms.

By

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Artificial Intelligence

What is Artificial Intelligence?

According to the father of Artificial Intelligence John McCarthy, it is "The science and engineering of making intelligent machines, especially intelligent computer programs". Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.

Philosophy of AI

While exploiting the power of the computer systems, the curiosity of human, lead him to wonder, "Can a machine think and behave like humans do?" Thus, the development of AI started with the intention of creating similar intelligence in machines that we find and regard high in humans.

Goals of AI

To Create Expert Systems: The systems which exhibit intelligent behavior, learn, demonstrate, explain, and advice its users.

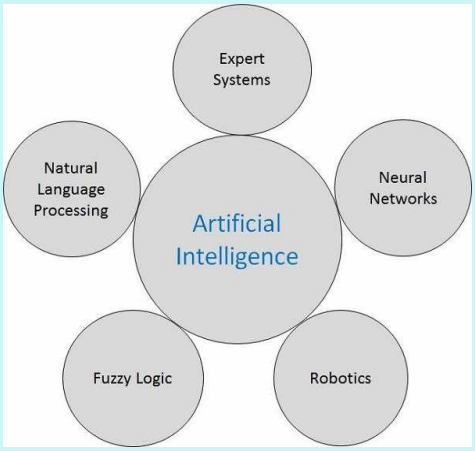
To Implement Human Intelligence in Machines: Creating systems that understand, think, learn, and behave like humans.

What Contributes to AI?

Artificial intelligence is a science and technology based on disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering. A major thrust of AI is in the development of computer functions associated with human intelligence, such as reasoning, learning, and problem solving. Out of the following areas, one or multiple areas can contribute to build an intelligent system.

What is AI Technique?

In the real world, the knowledge has some unwelcomed properties:



- Its volume is huge, next to unimaginable.
- It is not well-organized or well-formatted.
- It keeps changing constantly. AI Technique is a manner to organize and use the knowledge efficiently in such a way that: It should be perceivable by the people who provide it.
- It should be easily modifiable to correct errors.
- It should be useful in many situations though it is incomplete or inaccurate. AI techniques elevate the speed of execution of the complex program it is equipped with.

Applications of AI

- AI has been dominant in various fields such as:
- Gaming AI plays crucial role in strategic games such as chess, poker, tic-tac-toe, etc., where machine can think of large number of possible positions based on heuristic knowledge.
- Natural Language Processing It is possible to interact with the computer that understands natural language spoken by humans.
- Expert Systems There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users.
- Vision Systems

These systems understand, interpret, and comprehend visual input on the computer. For example,

A spying aeroplane takes photographs which are used to figure out spatial information or map of the areas.

Doctors use clinical expert system to diagnose the patient.

Police use computer software that can recognize the face of criminal with the stored portrait made by forensic artist.

Speech Recognition

Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it. It can handle different accents, slang words, noise in the background, change in human's noise due to cold, etc..

Handwriting Recognition The handwriting recognition software reads the text written on paper by a pen or on screen by a stylus. It can recognize the shapes of the letters and convert it into editable text.

By

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MOBILE VOTING SYSTEM USING IRIS RECOGNITION AND CRYPTOGRAPHY TECHNIQUES

With the advancement of electronics and computer science, mobile communication technology leads us to a fast moving entirely different world. In this scenario, we have lot of responsibilities, one of it is voting for our country, but even we don't have time for it, and also our votes may not useful to our nation, because of fake votes and cheating process happened during the election. This problem is rectified by the latest voting system as “Mobile Voting Sysdtem” which is discussed in this paper. The mobile voting system uses the efficient techniques, iris recognition and cryptography for the secured voting process. The iris recognition and cryptography avoids the fake votes and cheating process. The election commission spends lot of money, for each election unnecessarily, which will be minimized by this system. This system enables the voter to vote to the Nation from his place itself.

Mobile voting system use the iris recognition and cryptography techniques, for voting purpose, the encryption algorithm is uploaded in the mobile phone. As like the eye scanner which scans the iris is fixed in the mobile, so the mobile phone having camera is preferred for that. To obtain the voting the voters eye iris is recognized. During the transmission from the source (mobile) to destination (election database system) the data is encrypted using the encryption algorithm. The data sending and receiving is doing with the help of the mobile networks.

As democracies across the globe fight challenges related to electronic voting systems, here a mobile phone-based voting system that incorporated into the current large-scale election process, gives the promising research. Traditionally, voting process is organized in centralized or distributed manner called voting booths. The earlier process of election is quite complex and time consuming. People were waiting in queue for long time. To reduce this problem mobile voting system is introduced. This mobile voting system provide many benefits like we don’t need to go to polling booths, no need to use paper ballots and we have time and cost efficiency and it also avoid tiredness and violence . In our system there is no expensive hardware is used. For the different reasons, voters may not able to come to the voting booths physically, but now with the use of this new system he can vote remotely. For example, he can vote from home or while travelling abroad or sitting in the Office. That’s why there is more demand for remote voting. In this system procedures are easy, transparent and most secure.

Today the most common way for remote voting is postal voting, where voters cast their votes by cell Phones...Internet voting was introduced to provide more flexibility. Because of the inherited security vulnerabilities Of the Internet and computerized systems. In general, Phone Voting System (MPVS) provides mobility feature. Internet voting there is awide range of criticism. Mobile However this technology accesses certain security threats for its successful implementation in election. Without eliminating these security threats like buying a vote and Coercion, online registration, secrecy of ballot, anonymity of voter and double voting this latest technology can’t be allowed. An efficient and reliable system is essential for the trustworthy and successful implementation of this technology. In our

system we design mobile application for e-voting (electronic voting) process.

The proposed system uses mobile phone device having: small in size, low power, low-price as compared to computers and Direct Recording Electronic voting System, Electronic Voting Machine’s, provide mobility feature and security. Proposed system uses Global System for Mobile Communication technology which is a secure and globally used mobile technology in the current situation. Mobile phone also uses Subscriber Identity Module technology which provides user identity privacy, user identity verification and subscriber data secrecy providing more security to the proposed system.

The key features of our proposed Mobile Phone Voting System is :

Eligibility:

1.only authorized voter can cast their vote.

2.Uniqueness: Each user can cast their only one vote.

3.Integrity: Valid vote should not be modified or deleted.

4.Fairness: The election result should not be accessible before the official time ended.

5.Secrecy: No one should be able to find how voter cast their vote. 4.

6.Cost-effectiveness: Election system should be efficient and affordable.

IRIS RECOGNITION

Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of one or both of the irises of an individual's eyes, whose complex random patterns are unique, stable, and can be seen from some distance.

Retinal scanning is a different, ocular-based biometric technology that uses the unique patterns on a person's retina blood vessels and is often confused with iris recognition. Iris recognition uses video camera technology with subtle near infrared illumination to acquire images of the detail-rich, intricate structures of the iris which are visible externally. Digital templates encoded from these patterns by mathematical and statistical algorithms allow the identification of an individual or someone pretending to be that individual. Databases of enrolled templates are searched by matcher engines at speeds measured in the millions of templates per second per (single-core) CPU, and with remarkably low false match rates.

Several hundred million persons in several countries around the world have been enrolled in iris recognition systems for convenience purposes such as passport-free automated border-crossings and some national ID programs. A key advantage of iris recognition, besides its speed of matching and its extreme resistance to false matches, is the stability of the iris as an internal and protected, yet externally visible organ of the eye.

Visible wavelength (VW) vs near infrared (NIR) imaging

All publicly deployed iris recognition systems acquire images of an iris while being illuminated by light in the near infrared wavelength band (NIR: 700–900 nm) of the electromagnetic spectrum. The majority of persons worldwide have "dark brown eyes", the dominant phenotype of the human population, revealing less visible texture in the VW band but appearing richly structured, like the cratered surface of the moon, in the NIR band. (Some examples are shown here.) Using the NIR spectrum also enables the blocking of corneal secular reflections from a bright ambient environment, by allowing only those NIR wavelengths from the narrow-band illuminator back into the iris camera.

Iris melanin, also known as chromospheres, mainly consists of two distinct heterogeneous macromolecules, called eumelanin (brown–black) and pheomelanin (yellow–reddish), whose absorbance at longer wavelengths in the NIR spectrum is negligible. At shorter wavelengths within the VW spectrum, however, these chromospheres are excited and can yield rich patterns. Hussein, et al. provide a comparison between these two imaging modalities. An alternative feature extraction method to encode VW iris images was also introduced, which may offer an alternative approach for multi-modal biometric systems.

OPERATING PRINCIPLE

An iris-recognition algorithm can identify up to 200 identification points including rings, furrows and freckles within the iris. [9] First the system has to localize the inner and outer boundaries of the iris (pupil and limbos) in an image of an eye. Further subroutines detect and exclude eyelids, eyelashes, and secular reflections that often occlude parts of the iris. The set of pixels containing only the iris, normalized by a rubber-sheet model to compensate for pupil dilation or constriction, is then analyzed to extract a bit pattern encoding the information needed to compare two iris images.

In the case of Dagan's algorithms, a Gabor wavelet transform is used. The result is a set of complex numbers that carry local amplitude and phase information about the iris pattern. In Dagan's algorithms, most amplitude information is discarded, and the 2048 bits representing an iris pattern consist of phase information (complex sign bits of the Gabor wavelet projections). Discarding the amplitude information ensures that the template remains largely unaffected by changes in illumination or camera gain (contrast), and contributes to the long-term usability of the biometric template.

For identification (one-to-many template matching) or verification (one-to-one template matching), a template created by imaging an iris is compared to stored template in a database. If the Hamming distance is below the decision threshold, a positive identification has effectively been made because of the statistical extreme improbability that two different persons could agree by chance ("collide") in so many bits, given the high entropy of iris templates.

ADVANTAGES

The iris of the eye has been described as the ideal part of the human body for biometric identification for several reasons:

It is an internal organ that is well protected against damage and wear by a highly transparent and sensitive membrane (the cornea). This distinguishes it from fingerprints, which can be difficult to recognize after years of certain types of manual labor. The iris is mostly flat, and its geometric configuration is only controlled by two complementary muscles (the sphincter pupillae and dilator pupillae) that control the diameter of the pupil. This makes the iris shape far more predictable than, for instance, that of the face.

The iris has a fine texture that—like fingerprints—is determined randomly during embryonic gestation. Like the fingerprint, it is very hard (if not impossible) to prove that the iris is unique.

By

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Wireless Power Transmission via Solar Power Satellite

A major problem facing Planet Earth is provision of an adequate supply of clean energy. It has been that we face "three simultaneous challenge population growth, resource consumption, and environmental degradation all converging particularly in the matter of sustain energy supply."

Space-based solar power (SBSP) is the concept of collecting solar power in space (using an "SPS", that is, a "solar-power satellite" or a "satellite power system") for use on Earth. It has been in research since the early 1970s.

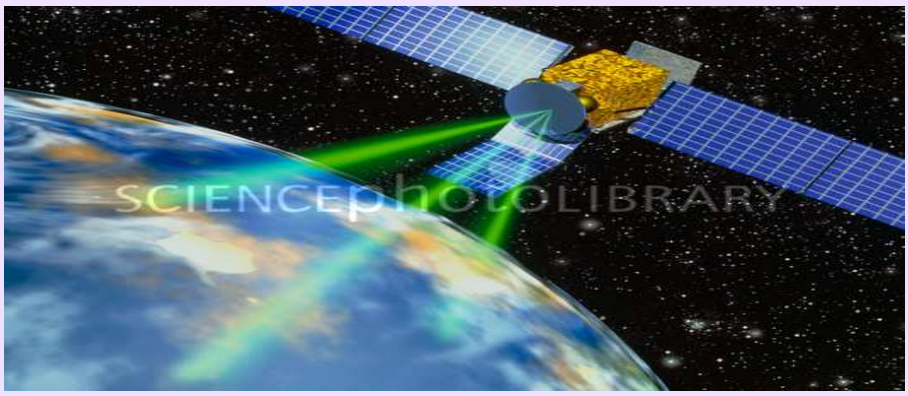
SBSP would differ from current solar collection methods in that the means used to collect energy would reside on an orbiting satellite instead of on Earth's surface. Some projected benefits of such a system are a higher collection rate and a longer collection period due to the lack of a diffusing atmosphere and night time in space.

Part of the solar energy (55–60%) is lost on its way through the atmosphere by the effects of reflection and absorption. Space-based solar power systems convert sunlight to microwaves outside the atmosphere, avoiding these losses, and the downtime (and cosine losses, for fixed flat-plate collectors) due to the Earth's rotation.

Besides the cost of implementing such a system, SBSP also introduces several new hurdles, primarily the problem of transmitting energy from orbit to Earth's surface for use. Since wires extending from Earth's surface to an orbiting satellite are neither practical nor feasible with current technology, SBSP designs generally include the use of some manner of wireless power transmission. The collecting satellite would convert solar energy into electrical energy on board, powering a microwave transmitter or laser emitter, and focus its beam toward a collector (retina) on Earth's face. Radiation and micrometeoroid dam age could also become concerns for SBSP.

SBSP is considered a form of sustainable or green energy, renewable energy, and is occasionally considered among climate engineering proposals. It is attractive to those seeking large-scale solutions to anthropogenic climate change or fossil fuel depletion (such as peak oil).

SBSP is being actively pursued by the Japan and China. In 2008 Japan passed its Basic Space Law which established Space Solar Power as a national goal and JAXA has a roadmap to commercial SBSP. In 2015 the China Academy for Space Technology (CAST) briefed their roadmap at the International Space Development Conference (ISDC) where they showcased their road map to a 1 GW commercial system in 2050 and unveiled a video and description of their design.



A proposal for the United States to lead in Space Solar Power has recently received high level attention after it won the D3 (Diplomacy, Development, Defense) competition sponsored by the Secretary of Defense, Secretary of State, and USAID Director. As of May 21, 2015, there was an on Change.org and a second active petition at Whitehouse website.

DISCONTINUATION

The project was not continued with the change in administrations after the 1980 US Federal elections. The Office of Technology Assessment concluded that "Too little is currently known about the technical, economic, and environmental aspects of SPS to make a sound decision whether to proceed with its development and deployment. In addition, without further research an SPS demonstration or systems-engineering verification program would be a high-risk venture."[28]

In 1997 NASA conducted its "Fresh Look" study to examine the modern state of SBSP feasibility. In assessing "What has changed" since the DOE study, NASA asserted that the "US National Space Policy now calls for NASA to make significant investments in technology (not a particular vehicle) to drive the costs of ETO [Earth to Orbit] transportation down dramatically. This is, of course, an absolute requirement of space solar power."[29]

Conversely, Dr. Pete Worden claimed that space-based solar is about five orders of magnitude more expensive than solar power from the Arizona desert, with a major cost being the transportation of materials to orbit. Dr. Worden referred to possible solutions as speculative, and that would not be available for decades at the earliest.

By

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Skin put Technology

Devices with significant computational power and capabilities can now be easily carried on our bodies. However, their small size typically leads to limited interaction space (e.g., diminutive screens, buttons, and jog wheels) and consequently diminishes their usability and functionality. Since one cannot simply make buttons and screens larger without losing the primary benefit of small size, one has to consider alternative approaches that enhance interactions with small mobile systems.

One option is to opportunistically appropriate surface area from the environment for interactive purposes. For example, there is a technique that allows a small mobile device to turn tables on which it rests into a gestural finger input canvas. However, tables are not always present, and in a

mobile context, users are unlikely to want to carry appropriated surfaces with them (at this point, one might as well just have a larger device). However, there is one surface that has been previously overlooked as an input canvas and one that happens to always travel with us: our skin.

Appropriating the human body as an input device is appealing not only because we have roughly two square meters of external surface area, but also because much of it is easily accessible by our hands (e.g., arms, upper legs, torso). Furthermore, proprioception –the sense of how our body is configured in three-dimensional space – allows us to accurately interact with our bodies in an eyes-free manner. For example, one can readily flick each of the fingers, touch the tip of the nose, and clap hands together without visual assistance. Few external input devices can claim this accurate, eyes-free input characteristic and provide such a large interaction area.

In this paper, a method that allows the body to be appropriated for finger input using a novel, non-invasive, wearable bio -acoustic sensor is presented; namely Skinput. The contributions of this paper are:

- Description of the design of a novel, wearable sensor for bio-acoustic signal acquisition.
- An analysis approach that enables to resolve the location of finger taps on the body.
- Assessment of the robustness and limitations of this system through a user study.
- Exploration of the broader space of bio-acoustic input through prototype applications and additional experimentation.

HARDWARE ARCHITECTURE

To expand the range of sensing modalities for always available input systems, a novel input technique that allows the skin to be used as a finger input surface is described in this paper and is named as Skinput. In this prototype system, the focus is on the arm (although the technique could be applied elsewhere). This is an attractive area to appropriate as it provides considerable surface area for interaction, including a contiguous and flat area for projection (discussed subsequently).

Furthermore, the forearm and hands contain a complex assemblage of bones that increases acoustic distinctiveness of different locations. To capture this acoustic information a wearable armband that is non-invasive and easily removable is developed. In this section, the mechanical phenomenon that enables Skinput is discussed, with a specific focus on the mechanical properties of the arm. The Skinput sensor and the processing techniques used to segment, analyze, and classify bio -acoustic signals are studied in this section.

Major Components are

Bio-Acoustics

Sensing

Armband Prototype

Processing

APPLICATIONS

- A method for controlling an iPod with skin-touch based input to select music tracks while jogging.
- It turns the fingers into a controller for the game of Tetris.
- It may be used for dialing your phone on your arm.

ADVANTAGES

The projected interface can appear much larger than it ever could on a device's screen. One can also bring his arm closer to the face (or vice versa) to see the display close up. Dimming the lights creates an even greater color contrast if skin and the text are too similar in color during daylight.

By

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