

The International Network on Appropriate Technology



Proceedings of the **7th International Conference on Appropriate Technology** **“Sustainable Technologies to Empower Communities** **– Bridging Theory with Practice”**

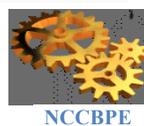
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Edited by

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SANKOFA: A Semantic Web Knowledge Sharing Collaborative Framework for ICAT Conferences

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Abstract:

*International Conference on Appropriate Technology ICAT is the flagship of International Network on Appropriate Technology INAT. While the conferences are the rich heritage of appropriate technology researches and practices, the INAT is the typical Community of Practice CoP that promotes AT to empower poorer people to achieve sustainable development. The Conferences create vibrant researchers and practitioners network and evolved Appropriate Technology AT body of knowledge. We propose **Sankofa** as a Collaborative Framework that fostering the networking among the INAT CoP and enrich AT knowledge representation through transformation of conference publications to Resource Description Framework RDF, Linked Data and semantic web technology. We utilize RDF Meaningful Bibliographic Metadata M2B representation based on Interlinked AT concepts ontology developed through subject heading, taxonomies, Topics, Associations, and Occurrences TAO, keywords, text mining, authors, and institution network analysis. The Ontology and Linked Data enrich the search with the vast web of connected concepts which ensure systematic collaboration of ontology revision, grown AT Knowledge Base, and dynamics interaction with knowledge. Research blogging about peer reviewed papers and consultation within intra CoP enable further experts networking realize Science 2.0. The proposed Framework is guided by Simple Knowledge Organization System SKOS and implemented in current Durpal Content Management Platform that support current conference website.*

Keywords: Appropriate Technology, Community of Practice CoP, Linked Data, Sankofa, Semantic Web.

Introduction

The Appropriate Technologies movement is a multidisciplinary approach where scientists, economists, engineers, NGO, community-based organizations collaborate together to develop the technologies for the community. In such context, mobilizing the networking between the stakeholders is crucial in addition to the scholar's community that intently responsible about the systematic building of the Body of Knowledge BOK and best practices of the field. The History of Appropriate Technologies movement has high correlation with development and recently with sustainable development and social innovation and innovation at grassroots (Smith, A., et al 2003). The movement inspired by Mahatma Gandhi and his approach to developing India villages, the economist Schumacher incorporates this philosophy in his seminal work (Small is beautiful) and implement ideas around the concept by establishing the Intermediate Technology Group ITG later become the NGO Practical Action. The movement now has a broader umbrella which seeks innovation processes that are sustainable and socially inclusive toward local communities where local knowledge and innovation lead the collaboration and innovation activities (Smith, A., et al 2003).

International Conference on Appropriate Technology (ICAT) represents one of greatest dedicated efforts to promote the appropriate technology movement. Searching large publication

sites such as Elsevier, Directory of Open Access Journal (DOAJ), ScienceDirect and Scopus shows few findings that have direct relation with AT. Dedicated Journals for appropriate technologies are not as much wide-spread, available or well-represented to end users. Only one related journal was listed in Scopus directory (Appropriate Technology, ISSN 03050920), while there are three journals in ScienceDirect have direct links to the AT topic (when the term Appropriate Technology was as the search key), mainly Water Science and Technology, Waste Management, and Physics and Chemistry of the Earth.

Due to the mentioned above limitations, ICAT conference knowledge is seen as a rich resource of dedicated researches and practices on appropriate technologies. The community of International Network for Appropriate Technology INAT is the best example of Community of Practice (CoP) and Network that create and disseminate the AT Body of Knowledge.

This paper looks to INAT as Community of Practices (CoP) that produces AT BOK through ICAT conferences. We look back to these conferences, inspired by African symbolism Sankofa and the proverb associated with it which can be interpreted “It is not wrong to go back for that which you have forgotten” (Wikipedia 2016). ICAT publications were explored and examined to discover INAT network dynamic and demography in order to strength ICAT network and create collaborative platform that foster systematic building of AT BOK. Bibliographic metadata will be used to describe all conferences resources, in addition to the text mining techniques which will help in semantic representation of ICAT conferences. This representation will ease the access to current publication database, established interlinked documents with both interlinked open data and concept ontology, fostering network collaboration and enable systematic growth of ontology related to AT BOK. Such representation will aid the exploration discoveries that ease retrieval and guide science policy.

The rest of this paper discusses the background of study by giving a literature review in the following section, discussing the methodology in the third section, presenting the results in the fourth section, and concluding in the final section.

Literature Review

The emergence of new technologies has inspired how searching methods should adapt the increasing of the volume of published works, which would result in a better and more optimized approach in accessing knowledge, networking and communication. Social networking websites that targets researchers are getting popular, mentioning: ResearchGate, Academia and Mendeley as examples. The tremendous access of the scientific research database come from giant publisher platform as *Elsevier*, Directory of Open Access Journal (*DOAJ*), and *ScienceDirect*.

Recently many projects unlock the power of the semantic web and open data to provide both human and machine easy knowledge access (REEP, 2016) (OpenEI, 2016) (Open Data United Nations, 2016). The capabilities to represent bibliographic metadata as RDF, in addition, to represent all domain ontology using simple logic implemented in RDF triplet transform the web from a web of connected documents to a web of connected concepts and topics. Such transformation open seamless knowledge consumption using a machine and paved the way to linked open data (LOD2, 2016) (DBpedia, 2016).

Development of domain knowledge-based ontology is an intensive collaboration work that involved a large number of domain experts. One of the most useful research in this area is AGROVOC, a useful example in providing semantic standards to facilitate cooperation and data exchange. This research focused on technical level which used to index all documents in

agriculture research by using linked data approach, AGROVOC success to extract and build over 32,000 concepts available in 23 languages (FAO, 2016).

In this research, we aim to apply a new facility, effectiveness, and procedures that allow libraries to create a new bibliographic metadata infrastructure on Drupal system, so through specific modules (like DSpace) by recreating detailed metadata of conference publications additional to the already being followed clustering. Bibliographic metadata should be defined by authors, keywords, institutes, and concept of publications that is simulated for DSpace system repository, as platform for all researchers and organizations to participate and networking as large. The challenge of this research how can transform the presented platform to enable easy knowledge access and efficient research social networking.

The current ICAT conferences classification and clustering for publication is based on conferences theme and subtheme. Each conferences paper is grouped under conference theme and subthemes as simple hyperlink access starting from the first conference in 2004. The hosting platform in the current implementation lacks the e-library capabilities. Since it implements the conference archive by direct hyperlink to the conference subtheme document rather than separated paper for each work. To mention some examples of other approaches with similar goals to our presented work, we found that Engineering for Change (Engineering for Change, 2016) has many similar objectives with INAT, for improving the quality of life through building a multidisciplinary coalition of change agents. Their partners include IEEE, American Society for Mechanical Engineering ASME, and Engineering without Borders EWB-USA. Their website better in solution library categorization, tagging, indexing, and in promoting blogging about new challenges and solutions.

Many others utilize this ontology representation power in other form enhancing interlinked navigational tool in space of library knowledge and information. Ontopia is based on the concept of Topic, Associations, and Occurrences (TAO) (Ontopia, 2012). The Topic mapping was standardized by ISO (Z39.19, 1993). The EconStor open access library uses TAO to expand the search space by cross- link two library using topic inside documents (EconStor, 2016).

Methodology

In order to explore and exploit the conference document in easy way, we first model the publication resources (Conference papers) into Bibliographic Metadata. This will help us to easily represent the resources using Resource Description Framework RDF and represent the AT BOK itself as interlinked concepts rather than keywords tagging document. A generic Duplin core approach similar to of FAO's Agriculture Information Management System was followed, and a series of metadata fields was identified for helping to build core semantic representation of the conference.

Beside Conference general theme, we identify the subfield of the conference, which represents a certain area of interest in appropriate technology domain, in addition to author attributes such as institute that appear in affiliations and institute countries. This way, a more helpful exploitation of authors' network and author topic associations will occur. Keywords were also extracted as metadata, which enriches the proximity of concepts in concept mapping and will be regarded as a prior knowledge in categorization the document into topics according to its word vector generated by text mining. We aim to have systematic resources description, which maximizes the retrieval and association capacity. We extracted basic Bibliographic metadata from all conferences using the following fields: The theme of the Conference,

subtheme, title, keywords, authors, institutions, and country. These raw data were then passed to Sci2, which is a tool to map author network, author-topic association, to reveal the nature of INAT current collaboration patterns and how it can be strengthened and utilized.

Linked Concepts associations

The Concept is the building block of the domain ontology. Ontology is a systematic way to represent domain knowledge in concept and proposition in predicate relations. ICAT conference will represent the core starting concept ontology which can be expanded and interlinked through concept mapping with other work in the field of AT. Concept editing, reviewing, and maintenance will enhance the collaboration to build domain ontology in addition to incremental learning since concept mapping is cognition learning model with the power of knowledge representation.

In order to enrich retrieval and association based retrieval, we introduce concept based search in addition to the bibliographic metadata search, where the document is associated with the concept using simple triplet (Topic, Association, Occurrence) TAO here we reduce the topic search to occurrences of the topic/concepts in the document body and its association to other topic (Pepper, 1999).

Topic maps are a new ISO standard for describing knowledge structures and associating with information resources. The association defined the relationship between the topic and other resources or subject which turn to be a topic, this clear triplet makes explicit knowledge representation, it builds a web of linked concepts (topic) with smart navigational capabilities. Nevertheless, the question is how in the first place, we define the topics or concepts that define the domain ontology.

For each subtheme, firstly we count all keywords that are used to describe the document by the author. They will provide the initial set of terms/Concepts, then more word statistics will be obtained through text mining. We use text processing module in Rapidminer software in order to implement text mining using typical mining process such as process document, tokenize, remove stopwords, and stemming. The result is a word vector that describe the subtheme. This word vector in addition to keywords vector will be the initial basis of the concepts/Topics. Later, we will enable the expert network for collaborative refine and build of the AT ontology. The proposition of these concepts which can be exploited in RDF predicate triplet will be obtained using Natural Language Processing NLP and refined with collaborated concept mapping and vocabulary development. Open tools such as GATE will be the choice for the extension work. Figure 1 illustrates the rapidminer process that extract words vector.



Figure 1. Rapidminer Text Mining process for the ICAT publication

Discovery of network's potentials from ICAT's Conferences

Follow *Sankofa* proverb, we need to look into our history and see how ICAT conferences build a dynamic network by analyzing authors' network and their institutions, countries, and topic associations. Such analysis will give us insight about collaboration network, expert's location, and topic coverage, we aim two folds from such research network analysis:

From discovered patterns, how we strength the ICAT collaboration network in order to promote the AT theory and practices with high efficiency. Secondly how the topic coverage will enable research policy in AT to address the gap and develop AT BOK. Further, then depending on analysis findings, we suggest how the INAT portal can foster the new desirable collaborations patterns and searching platform.

Best Practices of Community of Practice CoP

INAT is typical community of practices CoP with a well-defined mission to empower poorer people to achieve sustainable development. Here we examine in the light of the network analysis the best practices of CoP role that can be adopted by INAT. Fortunately, INAT can play more than one roles of CoP identified by APQC as best practices, it can develop and disseminate AT best practices to use, or steward the body of knowledge from which communities can draw, or innovate breakthrough ideas, knowledge, and practices. Since INAT is dominated with scattered researchers and practitioners across the globe, with current trends in communication technology, open access publication, and open data, INAT can catch opportunity and transform to real science 2.0 platform, this mainly through use of collaborative platform to foster research blogging, linked data representation of the knowledge in addition to open data which will be high valuable in context of development. The characteristics of such platform will be defined as a current science 2.0 attempts.

Result

ICAT Conferences start early at 2004, the conference witness a continuous growth in participation of researcher, which fallen in the 4th ICAT but ramp up again continuously up to the 6th ICAT conference, Figure 2 show the number of papers as proximity of the growth.

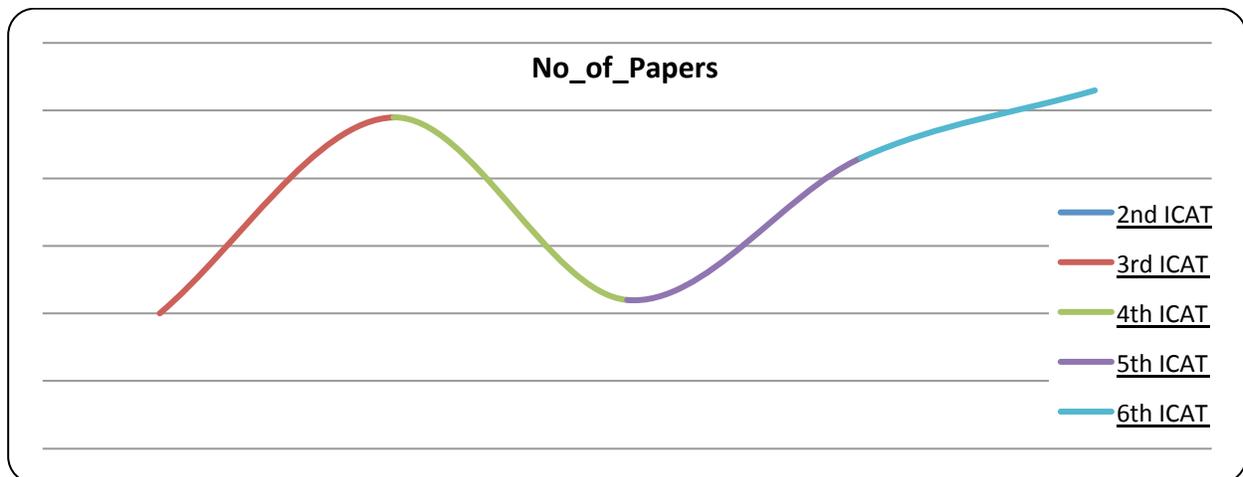


Figure 2. The Growth of ICAT knowledge base in term of number of paper (Author compiled Data)

The community behind the conference has grown to span over the south-south continents. Africa as the conference home, Asia and Latin America, over the over conference more than 382 researchers, consultants, practitioners were participated in producing 187 paper (Data from 5 conferences out of 6). Those experts belong to more than 244 institutions such as University's faculties, department, research centers, and development NGO. Although researchers come from 31 countries, but North Africa and West Africa countries have low rate

of participation as well as Europe and Asia. The numbers illustrated in the Table1 show how big the size and diversity of the network.

Table 1. The size of conference Network (Author compiled Data)

Conferences	No Papers	No Authors	No Institutes	Countries
*6	187	382	244	31

The ICAT conferences cover large area of development issues that had direct related to problem faced people in the developing countries. The topic range from Health, ICT, Water and Sanitation, to Knowledge Management and Technology Transfer, and Policy and Standards. Conference papers metadata are extracted which include authors, institutions, case's countries, and keywords. In addition to that, all documents are grouped according to above subthemes shown in Figure 2.

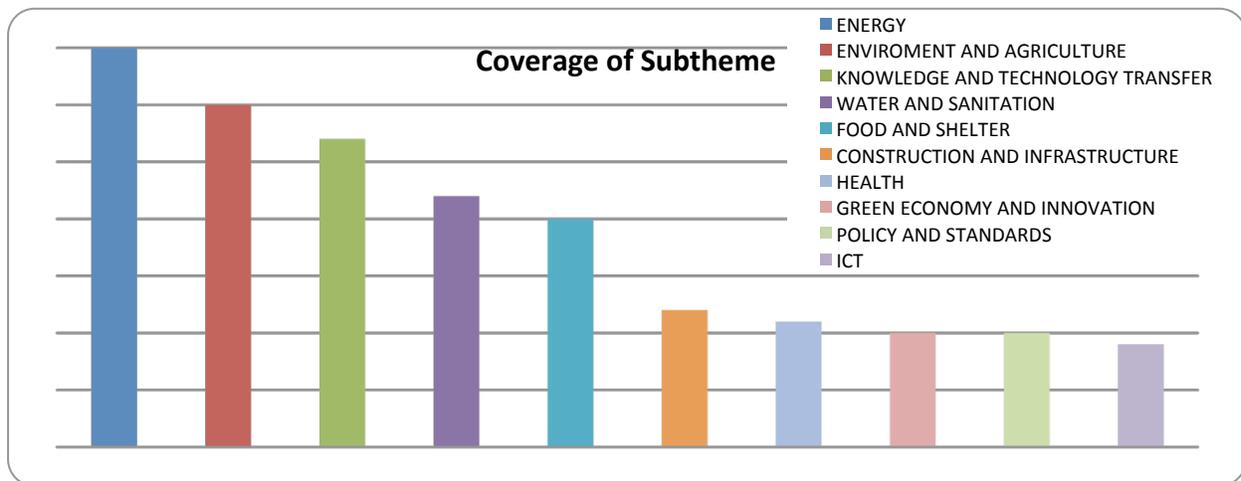


Figure 3. the Subtheme Coverage across ICAT Conference (Compiled Data)

We use *rapidminer* to generate words vectors and matrix associated to each subtheme topic using standard text mining process (text extraction, tokenize, stopwords filter, stemming, and text transformation) the generated words vectors will be the core for building ontology by the aid of keywords associated to each subtheme topic. This ontology will help both in retrieval and classification of the resources.

Conclusions

ICAT conference are examined as valuable source of Appropriate Technology knowledge, and INAT, the community behind it studied as community of practice CoP. The keywords analysis and word analysis show a potential to build conference e-library that embedded semantic capabilities through bibliographic metadata implemented in RDF and topic associations using concept ontology. We will utilize these entire infrastructures in redesign the conference portal to incorporate effective semantic based linked search and to adopt researchers and practitioner's expert directories and platform that fostering collaboration in building the AT ontology, research blogging, design open data, and help other in peer review. By this work, we aim to help in systematic growing of AT body of knowledge.

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Smart Lighting Institute: Summer Outreach Program

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Abstract

We present high school summer outreach program in science, technology, engineering and mathematics (STEM) areas using Smart Lighting Program as a case study. The continuous improvement or advanced standards of the citizens of any nation depends on continuous research and innovations. The US enjoys the global leadership role in developing and implementing cutting edge research. However, there are few underrepresented minority groups of researchers and educators in STEM. The contribution of a diverse population of scientists and engineers is necessary to meet the world's needs. There is a talented underrepresented group that needs to be tapped and trained for research and improved technology. Underrepresented high school students are invited to participate in summer outreach STEM program with the hope that they will pursue college education in STEM areas to improve their employability. We introduce STEM through lectures and hands on activities. The program includes daily activities coupled with field trips and presentations. Smart Lighting activities involve application of LEDs and solar power. The participants are introduced to instrumentation and use of mobile studio and Analog discovery. These are portable labs using a PC as the instrumentation. We do assessment for future improvement of program.

Keywords: employability, outreach, discovery, assessment.

Introduction

Howard University has been one of the educational outreach partners for the Smart Lighting Program, which is led by Rensselaer Polytechnic Institute (RPI) and funded by the National Science Foundation (NSF). Howard University's Electrical and Computer Engineering Department has been hosting the Smart Lighting Summer program for the past several years. One of the goals of this program is to introduce a wide range of engineering concepts to local High School students and encourage them to later major in Science and Engineering. This is a 4-week program offered in July. Participating students are selected from mostly Washington, DC metro (DC, Virginia, Maryland) area high schools from 10 - 12 graders.

During the Summer Program, students' learning activities are divided into several modules that are each taught by faculty and mentors. These modules include lectures that provide the theoretical background information about electrical and computer engineering concepts as well as hands on labs that give students practical views and experiences on some engineering systems. This program is divided into three modules. Module I covers introduction to engineering design principles. This guides outline of series of actions and tasks that can lead to a successful analysis, design, and implementation of an engineering project. A solar powered aerial cable car project is assigned; Module II covers introduction to engineering concepts, electrical engineering concepts, areas of concentration, and devices such as conductors, semiconductors, insulators, and circuit components such as resistors, capacitors, inductors, diodes, hands on projects AM/FM radio, traffic Light systems, communications (report writing,

oral penetrations); and Module III covers systems, devices and concepts, valuable feedback to students, electric circuits building, introduction to Python programming. In addition to the three modules, a mentor (graduate) student leads the students to conduct several labs activities, and guest lectures/speakers from industry (such as NASA) are invited to participate in the program.

Smart Lighting Institute

The main purpose of the Smart Lighting Program is to introduce high school students to pursue engineering education in future that will improve minority skills in their employability as well as make contributions to research. Presently, minority contributions in the STEM areas are rather low. The program introduces the students to general engineering education through lectures and hands on. They learn about electrical terms, quantities and how to use instruments to collect data. They learn how to use the Analog Discovery which is a personal instrumentation that contains function generator with leads that connect to bread board and then to the computer. It has dc power supplies as well as other signals. The computer is used as scope to get data.

Lectures

The program consists of three main modules plus invited guest lectures from industry. Each instructor (with mentors) with different background conducts the assigned module.

Module I: Introduction to engineering design principles and related assigned projects that. Frequently used vocabulary and key terms in science and engineering are first outlined and defined, as follows:

- Hypothesis- an educated guess or prediction to make
- Independent variable- controlled by the experimenter, maybe a measure of a parameter to determine the outcome. Dependent variable- variations because of independent variables observed or measured to collect data. Constant parameters- remain the same
- Quantitative observations- use of numbers to describe objects such mass, volume
- Qualitative observations- use of words to describe objects appearance, color, texture
- Inferences - an attempt to interpret observations. Questions- answers to the experiment.

After the above vocabulary and key terms are introduced, the instructor discusses the engineering design project guide that includes a set of steps to be followed in order to successfully complete an engineering analysis and design project (outlined below).

- Getting started, gathering data, generating ideas, implementing solution
- Engineering design process, define the problem, design notebook
- Background research, specifications. Brainstorm, multiple solutions choose optimal design. Implementing a solution- development work, prototyping, test and redesign.

After discussing the above necessary background for a successful completion of design project, students are assigned to solar-powered aerial cable car project in activities section Figure 1.

Module II: Lectures involve circuit theory, introduction to semiconductors with emphasis on LEDs and applications, hands on labs, instrumentation. Students learn how to use the analog discovery, a persona; instrumentation with built function generator and dc power supplies +/- 5 V. It works for analog and digital labs. concepts of conductors, semiconductors, insulators, AM radio, Figure 3, traffic light system, circuits elements such as resistors (color code), capacitors, inductors, diode, soldering techniques. Lectures include communications. Fundamental concepts of Amplitude modulation, how a message signal can be modulated by a carrier signal to produce an AM signal on the transmitter side. On the receiver side, demodulation is explained how to recover the AM signal. Students are also shown videos about how amplitude

modulation and demodulation work. After learning about the basic fundamentals, students are given an AM/FM radio kit with block diagram shown in Figure 3, an instruction manual containing the parts list needed for construction, and then asked to build the radio by soldering.

Module III: Provides students a wide range of activities such as Python Programming, circuit constructions, power point presentations, report writing. The lab activities include building circuits with topics about resistors, Ohm's Law and voltage divider, signal generators and waveforms, capacitors and time constant, inductors and resonance and 3D-Printer. The Python programming includes topics about Functions, variables, If Statements and many more.

Activities

Each module has lectures are coupled with hands on activities:

Solar-Powered Cable Car: This experiment uses a cable car that utilizes a solar panel to power it. The Aerial Solar Cable Car experiment encourages students to learn about how a solar panel works, the cable car works and what causes it to move based on design principles they pull from user profiles. This activity also encourages students to iterate on their designs and practice using different ideas and data. This exercise is a great way to push students to build, test and iterate while keeping their designs founded in engineering education. This activity also encourages critical thinking by asking students to synthesize their user's profile to find their needs. Specifications: Solar panel output 1.1 V, 75 mA, size: 11mm x110mmx180mm, unit wt 2.9 oz, solar cell life 2 years normal use, Motor Dc, power consumption 1.2 Vx10mA, Tools needed: diagonal cutter, screw driver, scissors. Each group (size 4-8, total 40 students) receives transport cable, automatic round trip return stoppers, solar panel and 30 plastic parts to assemble will be provided. Students will receive parts to build the item shown in Figure 1.

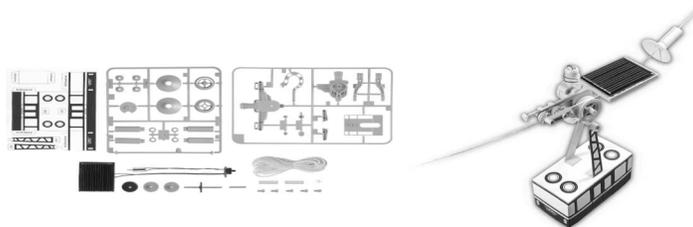


Figure 1. Solar powered aerial cable car parts and view

List of materials per team needed and a detailed step-by-step experimental procedure to complete the project's measurements and data gathering are outlined as follows: Parts- Solar cell, cable car, string, 2 poles, marker, stopwatch, pole/shadow, protractor, chalk

Procedure

- First, assemble the Aerial Cable Car., Next, arrange two poles on a level grassy area.
- Place the poles at least 54 inches apart from each other, attach the end of a string to each pole. Measure the poles at a 105 degree angle, if possible. Place the cable on the string.
- Place the string under the plastic wheel and up and around the pulley.
- Position the solar panel flat. Time the cable car at least 4 different hours.
- Examples: 12:30, 1:30, 2:30 and 3:30pm on a sunny day, or pick your own.
- The cable car is expected to go back and forth on the string at least six times each trial.
- There will be at least two trials per hour. Record the time for each trial with a stopwatch.
- Record the average time for the two trials per hour. Place a pole in the ground at the same angle to the poles with a string. Measure the angle of the shadow of the pole at each hour with a protractor. Each student writes a final project design report it is completed.

Report writing outline: The project report will just entail putting together the information collected into one document according to: acknowledgments and bibliography, a detailed description of your procedure, data analysis and discussion, results and conclusions. The report format includes these sections:

- Cover sheet and Title of project
- Abstract (Project Summary) - this is an abbreviated version of your report.
- Table of contents, List of questions, variables, and hypothesis
- Background research – What you did before starting the experiment
- Material list, Science Project Logbook (your experiment journal)
- Experimental Procedure, Data analysis and discussion- This section is a summary of what you found out in your experiment, observations, data table, and graph(s).
- Conclusions and Ideas for future research
- Acknowledgements – thank anyone who helped you with your science project
- Bibliography.

Traffic Light Project: After discussing a traffic light system’s elements and functions, the students are provided the traffic light kit below. They are asked to read the instructions and assemble all components on the board by soldering and conduct testing.

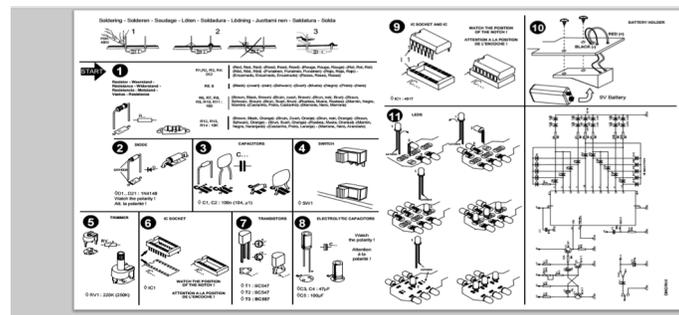


Figure 2. Traffic light kit

In order to construct the traffic light system, students use the information provided in Figure 2. It shows each of the components and a sequence of steps that must be taken for assembly.

AM/FM Radio Project: After learning about the basic fundamentals of AM/FM communication systems, students are given an AM/FM radio kit with block diagram shown in Figure 3, an instruction manual containing the parts list is provided, the circuit board and all parts needed for construction. They are then asked to build the radio by soldering each component onto the circuit board.

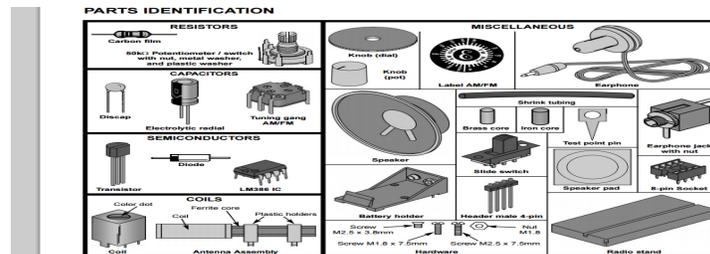


Figure 3. AM/FM radio system

Lab Hands On Activities

Students are introduced to several lab activities and safety where they learn about electric circuit components, such as resistors, capacitors, inductors, diodes, LEDs. They build and test several circuits using breadboards and the Analog Discovery. Samples of activities follow.

Activity 1: Resistors

In the first lab activity, students are introduced to the resistor circuit element. They learned about its physical characteristics, how to read a resistor value using its color code, and then measure its value using the Multimeter instrument. Each student is given several resistors and asked to compute the resistor value based on the color code, and then compared it to the value obtained from the Multimeter reading. This Lab is extended to Ohm's Law and voltage divider labs verification. An example of resistor color code is shown below:

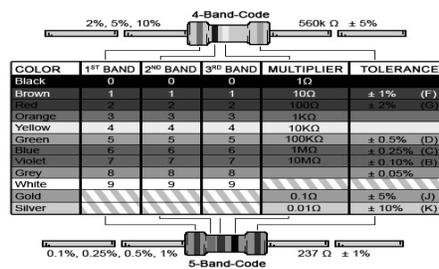


Figure 4. Resistor color code

Lab Activity 2: Signal generators and waveforms, and Analog discovery

During this lab experiment, students are introduced to the Diligent Analog Discovery instrument. They learn about its internal functions such as Oscilloscope, Arbitrary Waveform Generator, DC voltage generator, Network Analyzer, and others. After learning about the Analog Discovery (AD) instrument, students are asked to use a solder less breadboard and to construct the circuit in Figure 5 using 1 Kilo Ohm resistor and two Light Emitting Diodes (LED). The Analog Discovery is used to generate the sinusoidal input voltage with a frequency that is changed from 1 Hz to 60 Hz with an increment of 5 Hz. Students observe the behavior of each LED (off and on) with different time delay at variable frequencies of the input signal. Also, students used the measurement function built-in the AD to measure input and output voltage characteristics such as amplitudes, frequencies, periods, the input across the voltage source, and LEDs devices.

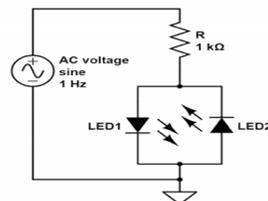


Figure 5. AC voltage circuit with flashing LEDs

Lab Activity 3: Capacitors and Time Constant

Students are asked to build on a solderless breadboard the circuit in figure xxx using 1 K-Ohm resistor and a capacitor with value 1 microfarad. The input voltage source is square

wave generated from the Analog Discovery with an amplitude of 500 mV and an offset of 500 mV.

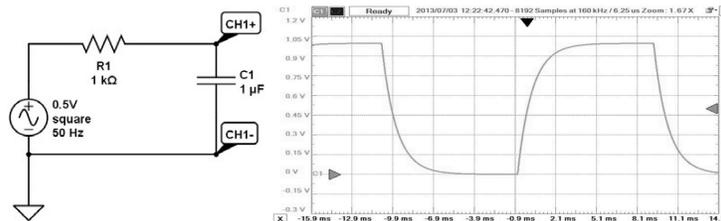


Figure 6. Capacitor circuit- charge discharge with square wave input

Students are instructed to observe the output waveform across the capacitor using the oscilloscope and to observe that the capacitor is charging and discharge as shown in figure 6. The calculated and measured time constant are also compared.

3D - Printer Activity

Students are introduced to the 3D-Printer in Figure 7. It can be used to print 3D-objects of difference sizes and forms. The printer comes assembled, the only installation done is about the control software package called Cura.



Figure 7. Printer software interface and 3D Printer

The software is downloaded to the computer connected to the 3d-Printer and several configuration parameters are set. The Interface allows the user to interact with the 3D-Printer in order to load models, set parameters, and print 3D-Objects. Students print 3D-Objects.

Python Programming

Students learn Python programming and its applications. The activities cover a wide range of Python programming topics, such as, Python If Statements, Variables, Functions, and Loops. Introduction to Python (Python IDLE). The Python 2.7 program is designed to be a simple way to begin writing code. Downloading Python: 1. Follow this link to download: bit.ly/pythonLE27, 2. Run the file and continue until the folder is downloaded, 3. Open the Python 2.7 folder, and open IDLE (Python GUI). 4. Browse through the Python 2.7 or search for IDLE via Starting to Code. Setting Variables: In any programming language, data can be stored in different data types, e.g. as strings or integers, and variables can be modified and printed.

Python If Statements: An If Statement is the way programmers ask the computer questions. If Statements are true/false questions that the computer can evaluate. The truth or falsity of a statement determines which steps the computer takes next in a program. If Statements have a particular design. The trigger for an If Statement is the word *if*(no caps). User Input: Programmers can make the computer ask for user input. Python Functions: is a reusable block of code that serves as a template for one or more actions. *print()* function and the *input()* Variables: 2 types of variables. Strings are groups of characters, and Integers are

numbers without decimals. Input function: [variable name] = input([Message you want the computer to ask]). Python Loops: is a short (one or two line) segment of code that allows the programmer to repeat lines of code until a certain condition is met. While Loops: The While loop looks and works similarly to the If Statement. Loops can easily be integrated into existing programs to make a program that lasts longer and has more utility. While Loops and Functions: Lines of code that begin with a hashtag are called comments. Programmers add comments to organize and label different parts of longer programs numbers and print their sum. While Loops and Input: is asking the user whether they would like to run the program again.

Conclusion

Howard University Electrical and Computer Engineering Department hosts the Smart Lighting program each summer where students from local High School are introduced to a wide range of engineering concepts and activities. Learning activities are divided into several modules. In these modules, students are involved in several activities that include lectures and labs using Analog Discovery, a personal instrumentation. They learn about engineering design process, AM/ FM radio systems, traffic light systems, Python programming, circuit building and testing, and other engineering concepts and devices. We do pre and post survey assessment of the program. Both results show participants enthusiasm and their desire to pursue STEM areas in their college education. The program is improved on yearly bases based on the students' surveys outcomes.

Acknowledgements

Our due thanks to the National Science Foundation (NSF) for supporting the Smart Lighting Summer Institute. Thanks also to participating students, faculty, mentors and invited guest lecturers for making the program a success.

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Modifications of the Use of the Raspberry Pi Camera

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Abstract

The Raspberry Pi is a credit-card sized computer originally designed for education, inspired by the 1981 BBC Micro. Creator Eben Upton's goal was to create a low-cost device that would improve programming skills and hardware understanding at the pre-university level. But thanks to its small size and accessible price, it was quickly adopted by tinkerers, makers, and electronics enthusiasts for projects that require more than a basic microcontroller (such as Arduino devices). The Raspberry Pi is slower than a modern laptop or desktop but is still a complete Linux computer and can provide all the expected abilities that implies, at a low-power consumption level.

Keywords: Inexpensive, Mobile device, Model A, Model B, Raspberry Pi

Introduction

The Raspberry Pi is an inexpensive, credit card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a device that permits people regardless of age to survey computing. They can also learn how to program in unbeknownst languages like Scratch and Python. It is capable of doing everything you can accomplish on a desktop computer including, browsing the internet, playing high-definition video, making spreadsheets, word-processing, and playing games.

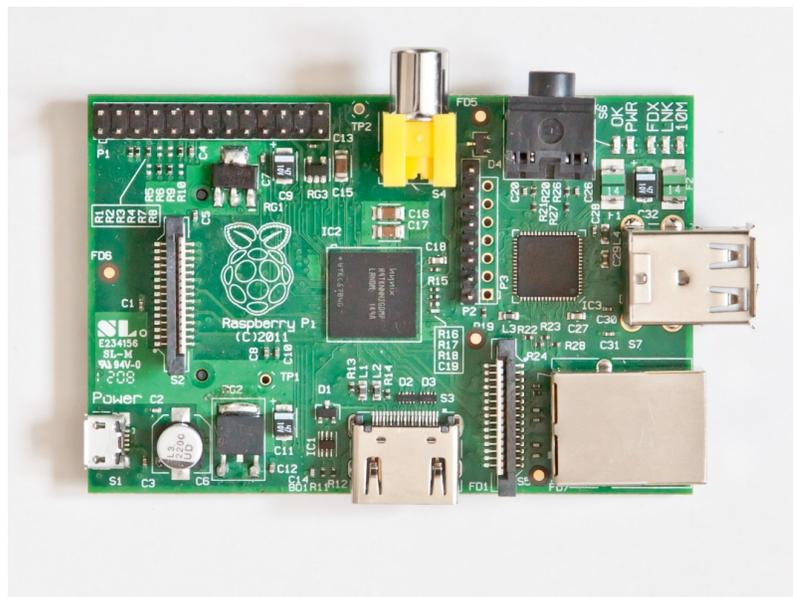


Figure 1. Raspberry Pi Computer

The Raspberry Pi has the capability to interact with the outside world, and has been used in an extensive selection of digital maker projects, including: music machines, parent detectors, weather stations, and tweeting birdhouses with infra-red cameras.

Development of Raspberry Pi

The Raspberry Pi Foundation is a registered educational charity built in the United Kingdom. The Foundation's goal is to progress the education of children and adults alike, predominantly in the field of computers, computer science and associated subjects.

The idea utilized a tiny and affordable computer for kids emerged in 2006. Eben Upton, Rob Mullins, Jack Lang and Alan Mycroft, based at the University of Cambridge's Computer Laboratory, became disturbed about the year-on-year decrease in the number and skill levels of the A level students applying to read Computer Science. Despite a situation in the 1990s where most of the kids applying were approaching an interview as knowledgeable hobbyist programmers, the terrain in the 2000s was extremely different. A usual applicant may have only done a little web design.

Something had altered the way kids were interacting with computers. Several problems were identified: the immigration of the ICT program with lessons on using Word and Excel, or writing web pages; the end of the dot-com boom; and the rise of the home PC and games console to replace the Amigas, BBC Micros, Spectrum ZX and Commodore 64 machines that people of an earlier generation learned to utilize this program.

There is not much any undersized group of people can do to tackle problems like an insufficient school syllabus or the end of an economic bubble. The idea that something could have been done regarding the circumstances of costly computers and mysterious programming tests that had to be prohibited by parents. From 2006 to 2008, the Raspberry Pi Foundation calculated innumerable versions of what has now become the Raspberry Pi.

By 2008, processors outlined for mobile devices had become more inexpensive, and powerful enough to supply exceptional multimedia, a feature that would make the board attractive to kids who would not be interested in a solely programmable-oriented device. The project started to look very feasible. Eben, Rob, Jack and Alan, teamed up with Pete Lomas, MD of hardware design and manufacture company Norcott Technologies, and David Braben, co-author of the seminal BBC Micro game Elite, to form the reality of the Raspberry Pi Foundation. Three years later, the Raspberry Pi Model B entered mass production through licensed manufacture deals with element 14/Premier Farnell and RS Electronics. Within the duration of two years, it had sold over two million units.

Types Raspberry Pi Computers

There are two Raspberry Pi models, A and B. They were named after the earlier spoken BBC Micro, which was also released in a Model A and a Model B. The A comes with 256MB of RAM and one USB port. It is cheaper and uses less power than the B. The current model B comes with a second USB port, an ethernet port for connection to a network, and 512MB of RAM.

The Raspberry Pi A and B boards have been upgraded to the A+ and B+ respectively. These upgrades make slight improvements, such as an improved number of USB ports and enhanced power consumption, particularly in the B+.

The Raspberry Pi is not the only miniature computing device available. In fact, there are countless other options obtainable. The Arduino is an additional hobbyist board, which is geared towards those wanting to build out electronics projects. Although the Raspberry Pi is a wholly functional Linux computer, the Arduino is only a microcontroller. This means it does not run an operating system, but instead, it runs a very specific, small block of code written by the person using the device. There are several add-on boards that give it more potential. Another option is

the Beaglebone sequence of boards, which are more related to the Raspberry Pi, but a little bit more potent. It is more expensive too.

Raspberry Pi Camera Project

Use the Raspberry Pi camera module to capture photos and video, so you have a portable camera for any situation.

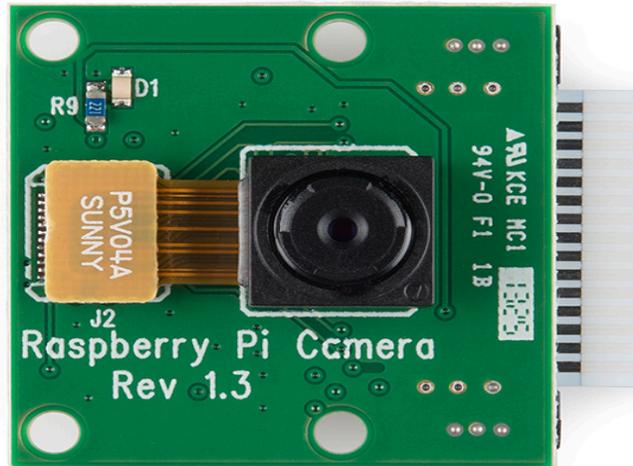


Figure 2. Raspberry Pi Camera

The Raspberry Pi module is an excellent addition to the Raspberry Pi. Not only does it slot into one of the non-traditional ports on the board itself, but it is also easily programmable within Raspbian. This gives it a few benefits over a USB webcam by not taking up any USB slots and being easier to control with code. It is also tiny, making it as portable as the Raspberry Pi itself.

Step 1. Plug In Your Computer

To attach the camera to the Raspberry Pi, pinpoint the connectors between the ethernet and HDMI port and slightly lift up the fastener. With the metal connectors facing away from the ethernet port, insert the camera board ribbon (Figure 3).

Step 2. Enable the Camera

First, make sure the camera modules are enabled. To begin the standard configuration screen, open a terminal and type: `$ sudo raspi-config`

Go down to Enable Camera, press Enter, and then simply find enable to confirm with another press of Enter. Select Finish and then reboot.

Step 3. Take Your First Picture

Capturing pictures with the Raspberry Pi Camera is simple. Just enter: `$ raspistill -o image.png`

This will show a five seconds snippet of the input of the camera and then seize the last frame of the video.

Step 4. Record Some Video

To record a video, a similar command is used, `raspivid`, like so: `$ raspivid -o video.h264`

Just like with the image capturing that was done in the earlier step, this will show a preview of what the camera is viewing. However, the video actually records the five seconds that make up the preview as well.

Step 5. Advanced Pi Camera Uses

If extra wants to be done with the camera, there is a simple Python wrapper presently obtainable called picamera. Installing it first from the terminal, using the following command:
\$ sudo apt-get install python-picamera

Step 6. Python Test

In order to make sure that everything is still working; enter a Python shell by typing 'python' into the terminal. Then type the following three lines:

```
import picamera  
camera=picamera.PiCamera()  
camera.capture('pythontest.png')  
camera.close()
```

Step 7. Test Explained

Press Ctrl+D to leave the Python shell. Code similar to the command line tools was just used to take a simple image called 'pythontest.png'. The most imperative thing done after that was 'camera.close', to be certain that the camera was turned off after use.

Step 8. Python Video

To record video with picamera, first set the resolution and then set a recording time.

```
import picamera  
camera=picamera.PiCamera()  
camera.resolution = (640, 480)  
camera.start_recording('firstvideo.h264')  
camera.wait_recording(60)  
camera.stop_recording()  
camera.close()
```

Step 9. More Code

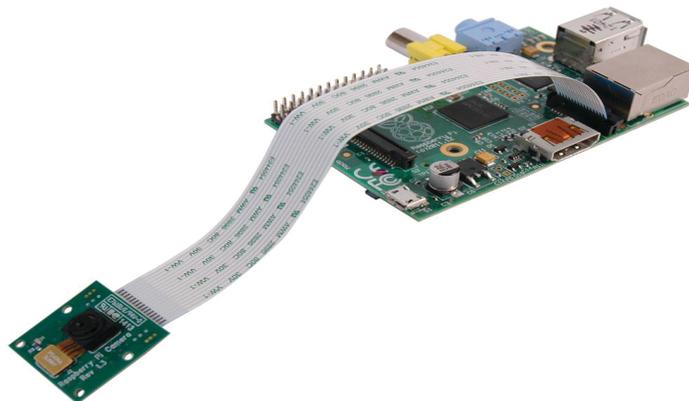


Figure 3. Attaching the camera to the Raspberry Pi

The above works better in a Python script. The wait is only really necessary if it is not possible to stop the recording. The pi camera module allows the creation of time lapses, modifying the frame rate of recordings and more.

Conclusion

In conclusion, the Raspberry Pi does not claim to have all the answers. It is believed that the Raspberry Pi is a fix to the entire world's computing issues. There is a strong yearning to break the standard where without spending hundreds of dollars on a PC, families cannot use the internet. Desired to be normal for children includes, owning a truly personal computer as well as looking forward to what the future has in store.

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Raspberry Pi Wireless Printing

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Abstract

Raspberry Pi as a wireless print server is an excellent improvement to home printing. As a desktop replacement and enabling output from laptops, smartphones, and tablets the Raspberry Pi wireless printer is being considered. In this paper, a variety of ways for using Raspberry Pi wireless printing is shared. Setting up the Raspberry Pi is clearly explained in a step-by-step method using a wireless USB dongle, Linux systems running Gnome, Mac, Canon Pixma MPI60 printer which can be used as a scanner and several others.

Keywords: USB dongle, CUPS (Common UNIX Printing System), NOOBS, SSH server; distros (Linux distribution, a specific vendor's operating system-package composed of the Linux kernel, GNU tools and libraries, additional software based).

Introduction

The best improvement to home printing is wireless technology. Wireless printing has fewer cables and flexibility on where your printer can be placed – its win-win. While it might be easy enough to buy a new printer for little or nothing and be unable to justify the outlay, the solution then, is to make it wireless. Several solutions are available, but one popular choice is to use your [Raspberry Pi](#) as a wireless print server.

Wireless printing has opened ways for making it possible to print to devices stored in remote rooms, sheds, closets, and cupboards. It has generally shaken up the whole process of printing and enabled output from laptops, smartphones, desktop computers and tablets. A brand new shiny printer is not needed for this to work; hats off to the Raspberry Pi, old printers without native wireless support do not have to end up in the trash bin.



Figure 1. Components of Raspberry Pi

Setting Up Raspberry Pi

The setup is simple. With your Raspberry Pi set up a wireless USB dongle, then connect your printer to a spare USB port on the computer. With Samba and CUPS (Common Unix Printing System) installed on the Raspberry Pi, all that is left to do is connect to the wireless printer from your desktop computer, install the appropriate driver and start printing.

CUPS give the Raspberry Pi a browser-based admin screen that can be viewed from any device on the network, enabling complete control over the wireless network printer. The basic components are Raspbian image; USB printer and USB wireless card.

Step 01 Make sure and check that the printer works!

Before starting, check that the printer to be sure it still works and has enough ink. The easiest way to do this is to check the documentation (online the manual is not available) and run a test print.

Step 02 Make absolutely sure to detect the printer! With Raspberry Pi set up as usual, the printer connected to a spare USB port, enter: `$ lsusb`

This will confirm that the printer has been detected by the Raspberry Pi. In most cases, displayed are the model and the manufacturer.

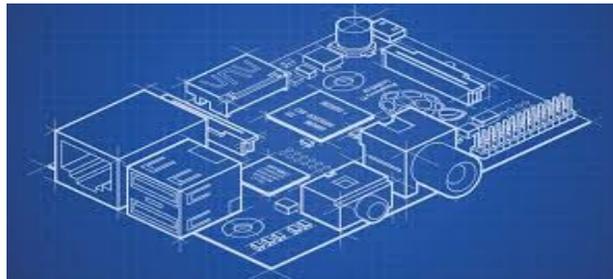


Figure 2. Raspberry Pi Blueprint

Step 03 Install Samba and CUPS Install Samba to enable file and print sharing across the entire network: `$ sudo apt-get install samba`

Next, it's time to install CUPS: `$ sudo apt-get install cups`. With a print server created, begin configuration by adding default user 'pi' to the printer admin group: `$ sudo usermod -a -G lpadmin pi`.

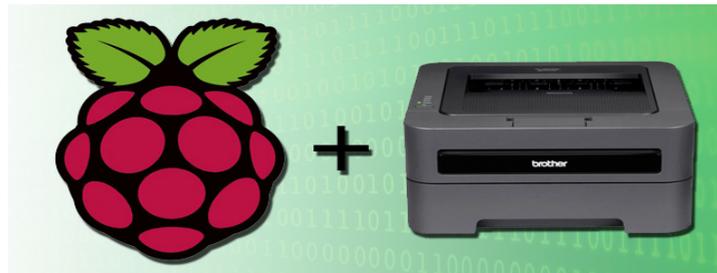


Figure 3. Connecting Your Printer to Raspberry Pi

Step 04 Set up Print Admin

Set up the CUPS print admin tool first. Boot into the GUI (startx) and launch the browser, entering 127.0.0.1:631.

Here, switch to Administration and ensure the 'Share printers' and 'Allow remote administration' boxes are selected. Next, select Add Printer and enter your Raspbian username and password when prompted.

Step 05 Add your printer

A list of printers will be displayed, so select yours to proceed to the next screen where you can confirm the details, add a name and check the Share This Printer box. Click Continue to load the list of printer drivers and select the appropriate one from the list.



Figure 4. Installing Cups for Raspberry Pi

Using A Raspberry Pi On Any Printer Can Turn Into A Wireless Printer

After buying a wireless printer, you will never want to go back to having to plug in all the time. But good wireless printers are expensive, and many routers that let you make network printers out of USB ones don't necessarily do all the driver-work for you.

Step 1: Set up your Operating System

This is pretty simple stuff if there is any knowledge about the RPi. Any OS should do, but make sure it has WICD for easy setup! If there is difficulty finding it on your OS, here is a good guide to setting it up from scratch.

Step 2: Setting up CUPS to print

CUPS is a printer driver to make Linux work more like Windows with printers. To install it, type this into terminal: `sudo apt-get install cups`

After that, add yourself to the CUPS admin files, with `sudo usermod -a -G lpadmin username`

Since CUPS does not have a standalone GUI, connect to it with a web browser. Find your IP address by typing in `ip addr show`.



Figure 5. Wireless Printing with Raspberry Pi

Then enter into a web browser your IP address followed by a colon then CUPS default port number of 631.

Click the "printers" tab and find the driver for the printer model. Install it, and then print a test page.

Step 3: Sharing the printer

Step 4: Finished!

The Pi Printer should be showing up from any other machine on the network as if it were a shared printer.

Rename it and give it a location! Use "Generic Postscript printer" on the connected machines since CUPS on the Pi is handling the printer-computer driver relations.

Unlike a typical Windows machine, the little Raspberry Pi running Raspbian doesn't exactly come with plug-n-play printer support.



Figure 6. Raspberry Pi + Wireless Printer

Why Do I Want to Do This?

If you are experimenting with the Pi as a desktop replacement, one must enable a physical print output for a program or application suite you're using, or otherwise want to enable traditional printing on your Pi, there's no previous printer wrangling under Linux experience required.

What Do I Need?

The following things are needed:

- 1 Pi unit with Raspbian installed
- 1 USB-based or network-accessible printer

If you have not yet configured your Raspberry Pi with a Raspbian image, we highly suggest starting with our introduction to the Rasp Pi.

Installing CUPS on the Pi and Enabling Remote Access

In order to link a printer with the Raspberry Pi, we first need to install Common UNIX Printing System (CUPS). It is time to fire up your Pi and navigate to the terminal.

At the terminal, enter the following command to install CUPS: `sudo apt-get install cups`

When prompted to continue, type Y and press enter. CUPS is a fairly beefy install, so feel free to go grab a cup of coffee. Once the base installation is complete, we need to make a few small administrative changes. The first order of business is to add ourselves to the user group that has access to the printers/printer queue. The user group created by CUPS is "lpadmin". The default Raspbian user (and the user we're logged into) is "pi" (adjust the following command accordingly if a different user is desired for access to the printer). At the terminal enter the following command: `sudo usermod -a -G lpadmin pi`

For the curious, the "-a" switch allows us to add an existing user (pi) to an existing group (lpadmin), specified by the "-G" switch.

How to Turn a Raspberry Pi into a Low-Power Network Storage Device

Mix together one Raspberry Pi and a sprinkle of cheap external hard drives and have the recipe. Our last step of pre-configuration work is to enable remote editing of the CUPS configuration. The rest of the configuration can be completed via the web browser on the Pi, but if you're not actually sitting right at the Pi and would prefer to use, say, the browser on your Windows desktop to complete the configuration, get a toggle a small value in `/etc/cups/cupsd.conf`.

Use a small, inconspicuous Raspberry Pi to convert the legacy USB printer to a new wireless network printer system.

A bulky, multifunction printer with a USB connection is no feast for the eyes, especially when it is sitting next to your up-market laptop or tablet. On the other hand, a network printer can disappear unobtrusively into a corner of the room and serve multiple users on the LAN. The convenience, flexibility, and invisibility of network printers is one reason why they have replaced their USB counterparts in many offices.

However, that is still no reason to drag your old USB printer down to the nearest recycling center. The Raspberry Pi can connect the USB world with the Internet, providing a print server service for your old USB clunker thanks to CUPS. With a wireless adapter plugged into your Rasp Pi, the location of your printer depends only on wireless reception and a suitable power supply.

Because USB-only printers are no longer in vogue, you can find used equipment at very reasonable prices. Thus, even if you cannot use your existing USB printer for this experiment, it might still be worthwhile purchasing a used printer for cost reasons. Used printers are up for grabs on eBay for less than twenty-five dollars.

The ingredients for a complete package as listed below, includes a second-hand multifunction Canon Pixma MP160 printer, which you can use as a scanner. At a total low cost of just under one hundred dollars, a complete package, including the printer itself, is still slightly cheaper than purchasing a comparable new, Wi-Fi-enabled printer.

Table 1. Chart of Products and Prices

Component	Source	Approx. Price (US\$ /EUR)
Canon MP160 multifunction printer	EBay	30/20
Raspberry Pi type B	Amazon	35/41
Rasp Pi case	Amazon	13/7
EDIMAX EW-7811UN wireless USB adapter	Amazon	12/11
Micro USB 5V power supply	Amazon	10/7
SD Card (2GB)	Amazon	10/6
Total		US \$ 110 / EUR 92

If individual components from the list are available among other IT relics – possibly, a micro USB power adapter from an old smartphone, a suitable SD card, or even a dusty old USB printer –offer a solution at an unbeatably low price.

Configuring the Network

Converting Raspberry Pi to Wireless Print Server 1 is easy. One must conduct Raspbian on the Raspberry Pi system, or use similar details for other Rasp Pi distress (Linux distribution, a precise vendor's operating-system-package devised of the Linux kernel, GNU tools and libraries, and additional software).

When the system is functioning properly, it is ready to put the Raspberry Pi on the home network. Like many other home networks, the router/firewall system assigns a network IP address to every device. The Rasp Pi system will request an IP address from the DHCP server running your home router by default.



Figure 7. Distributing Wi Fi

Although putting the Pi on the network is simple, a dynamic IP address given through a DHCP server can change whenever the system starts up and ask for a new address. If one desires to use the wireless printer as a perpetual part of the network, give it the Rasp Pi IP address. This way, other devices will know where to find it.

One may also assign the computer an enduring IP address by submitting its hardware address with the DHCP server. Check the vendor documentation for the home router for directions about how to log in the router's management interface.

If one desires the fixed IP address to be the Rasp Pi, and the router does not have an alternative for setting an address reservation, alter the configuration file on the Raspberry PI system.

Setting Up

When the printer service is functioning properly on the Raspberry PI system, adjust the other computers on the network to join it.

On Linux systems conducting Gnome, you reach the printer configuration by opening System settings. After selecting Unlock, click Add printer, and do exactly that. Gnome automatically finds the printer because it has enabled the proper services for the local network in the prior step.

All Windows systems have a similar method for adding a printer via the Control Panel. Look at your Windows Help System and remember, a network printer have been added, not a local printer.

When working with a Mac, select Systems Preferences from the Apple menu, and tap on Print & Fax. After this has been done, click on the plus sign at the end of the printer list, which brings Add Printer box. Next, click on the IP icon at the top and leave the Protocol as Line Printer Daemon – LPD in the Address box, type in the IP address of the computer. The Mac will proceed to search for the IP address and, if the previous steps have been done correctly, return

with a valid and complete address and the correct printer drive in the Print using the options box. Choosing Add brings up the Installable Options dialogue. Once clicking continues, your printer will pop up as a choice on the list of printers in the original Print & Fax dialogue. If you are dealing with an Android tablet, you can effectively use the Print Bot app to add your Raspberry PI printer.

Providing a Scanner

One will need the services of the Sane daemon lucid so you can release the printer's scan function on the network. The parallel Sane tools should automatically be set up after the installation of CUPS. If it is not there, visit a website to help cope with that. Next, change the startup behavior by altering the "no" to a "yes". Then add the entry for the local network.

On a Linux client, a call to scan an image will inform one whether the scan efficiency is convenient on the network. The scanner will come back with output.



Figure 8. Scanning Pictures + Documents

Benefits of Wireless Printing

It is amazing to have the commodity of wireless printing. This way, there will not be a giant hefty printer taking up excess space. There would not be any reason to be frustrated because of the lack of cords. With Raspberry PI, you free some space in your office for other things. Printing through any device is better when using wireless technology. It is really about making printing resilient to everyday tasks rather. Raspberry PI can help with this.



Figure 9. Raspberry Pi

Preparing for wireless printing with Raspberry Pi

Prepare for wireless printing with the Raspberry PI. At least one has to be connected to set up a wireless USB dongle. One should be using a USB printer. This can also work with a

parallel printer coupled with a parallel-to-USB adaptor. However, if there are problems, research this somewhere else.

Next, connect a USB cable from the printer to the Raspberry Pi. And finally, start the Raspberry Pi with the desired operating system. Remember to check if it is up-to-date.

Raspberry Pi from a Different Computer on the Network via SSH Server

If an HDMI is being used, display with a USB keyboard, and arrange Rasp Pi straight onto the device itself. However, a monitor or keyboard will not be connected. The second choice is to compose and conduct the Raspberry Pi from a different computer on the network via SSH. An SSH server usually comes with the installation. This removes any and all SSH based obstructions.

Conclusion

When using Raspberry Pi as a moderator, you can add printers with several uses and only one USB port to the local network in only a few steps. If correctly installed, your old printers will have a new take on life, with less money.

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Innovative Applications of Raspberry Pi

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Abstract

The Raspberry Pi is a complete low cost Linux computer that utilizes low- power consumption. In any case an electric homepage (or one with insufficient database use) or not so difficult homepage used for the improvement of websites. Setting up the Raspberry Pi as a web server known as an always-on device because of low-power needed. The Raspberry Pi can be placed beside a router and provide a basic website to guests, more effectively and efficiently. It can be utilized for some Pi projects, or maybe even a secret page to host photos or a CV. If one plans to use it as a web-facing apparatus, the Pi will absolutely have to be strengthened with a static IP address. A mandated network provider will offer static IP addresses for each of their users. Having the storage on an SD card makes it easy to swap with other SD cards running other GNU/Linux distributions to quickly and easily change the functionality of the Pi.

Keywords: Host, Server Ghost blogging platform, web server, Basic Raspberry Pi Setup, Setup Wi-Fi with a suitable dongle, static IP address, install Raspbian.

Introduction

When one cannot afford the hosting but need a website as an alternative, Raspberry PI is the answer. The Raspberry Pi is more than capable of running basic web server software. The setup is simply easy and creates easily the basic capabilities of a Raspberry Pi.

There are many good reasons for setting up a Raspberry Pi as a web server. For example, your desktop computer may not have system resources available to serve reliably. One may use a web server to offer content that anyone can access. Leaving this device switched on for long periods of time accommodates an on web server.

This paper will describe how to setup server hardware and the devices that will be connected such as the Ethernet or the Wi-Fi with a suit dongle.

Methods and Installation

The installation of Raspbian, direction on giving a static IP address, installation of Apache, PHP and associated Libraries and pointing your Domain Name: Handling Dynamic IP and Giving Access to the Pi from the World Wide Web will be described in this section.

Raspberry Pi Rev2 - Pi Connector



Figure 1. Raspberry Pi Rev 2 – Pi Connector

Step 1: Install Raspbian

- The easiest way to install Raspbian is go to the Raspberry Pi downloads page and download **Noobs**.
- Follow the steps described in the Noobs setup Guide to get your **Raspbian** running. In the initial setup page, select **Raspbian** and alleviate the rest of the options. The **default login** and **password** are “**pi**” and “**raspberry**” respectively.
- Change the default password of the Pi** during the first boot sequence in the Raspberry Pi configuration menu. One can always go back to the Pi configuration menu by typing in ‘**sudo raspi-config**’ at the command prompt.
- Complete the setup.
- Restart the Pi with a ‘**sudo reboot**’ command.

Step 2: Give the Pi a Static IP address

By default, the Pi is set to request a dynamic IP address from the router. One will need to change this setting to a fixed IP address. One will be hosting a webpage. The PI will need the address to be fixed.

Step 3: Install Apache, PHP and associated Libraries

For the Raspberry Pi to serve websites, one must install a web server. Apache is a program that listens to server access requests from internet browsers if permitted. To access a website on the Raspberry Pi one must install a web server.

Step 4: Pointing your Domain Name: Handling Dynamic IP and Giving Access to the Pi f

World Wide Web

Almost all ISPs provide a dynamic DNS address to your home internet connection. This is implemented for a variety of reasons. One reason is to prevent hackers from attacking a single address consistently.



Figure 2. Audio Injector Sound Card for the Raspberry Pi

Network Providers

There are many ways in which someone can enhance the effectiveness of their Raspberry Pi. However, set up server software on a USB hard disk drive in place of the SD card to reduce its degeneration throughout the regular write/read processes. On the other hand, an option is to try using your RAM device for limited read/write file storage. This is something perhaps one will change when one desires to use a very small web server. When opening access to the Raspberry Pi as Online Internet, attach the web server and structure the router with a static IP address, for safety, security and protection.

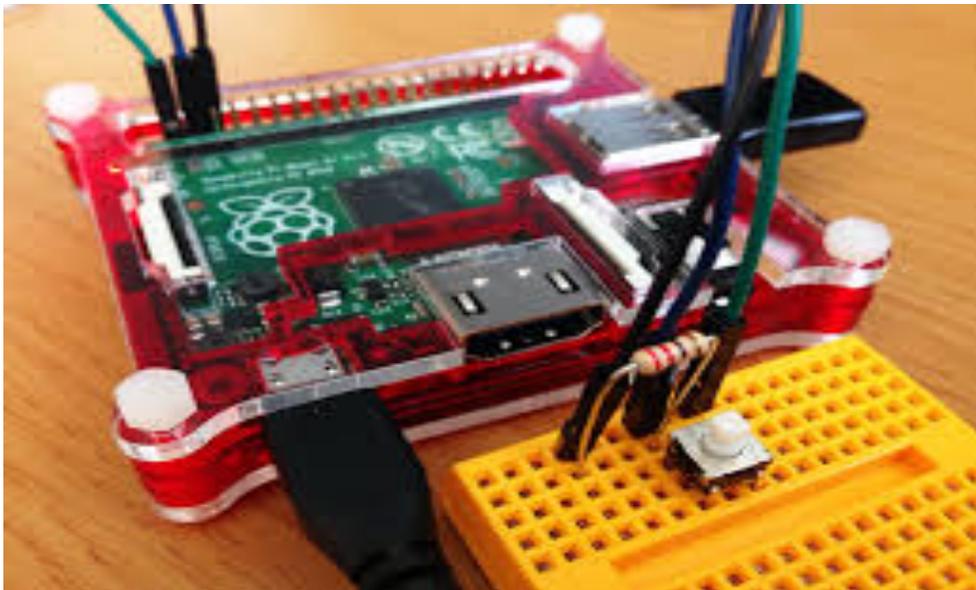


Figure 3. Raspberry Pi Alarm Clock

Uses and Benefits

The Raspberry Pi pulls an estimate of five to seven watts of energy. This number is about one tenth of what an equivalent full-size box can use. Since servers are being used non-stop day and night, the power consumption can really be cut down. I have read calculations that the basic Pi kit (Pi board, case, and power supply) will basically pay for itself with about a year's worth of power savings if it's left to run 24x7x365. At the end of the calculations, it ended up with the Cana Kit Basic Kit (ASIN # B00DG9D6IK) which is very affordable and good quality.



Figure 4. NAS Functionality for Raspberry Pi

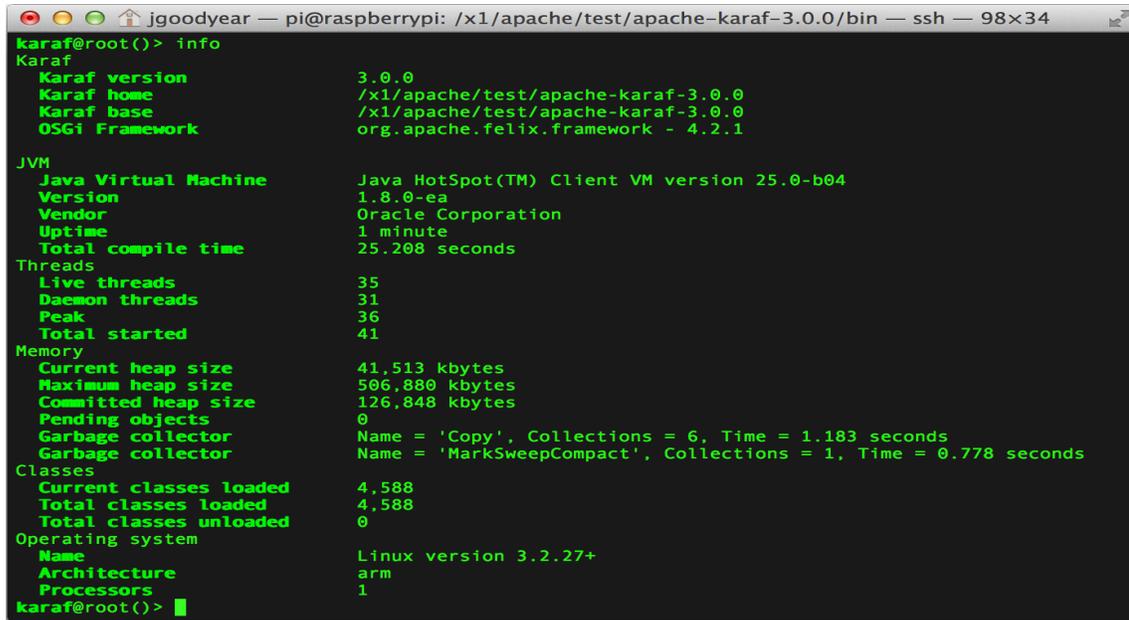
Having the storage on an SD card makes it easy to swap with other SD cards running other GNU/Linux distributions to quickly and easily change the functionality of the Pi. If you want to set up the Pi to run as a server to test it out, and then later try something else, just swap the SD card and you're done. Using the "dd" command on a GNU/Linux computer, a backup of the SD card can be created and later restored if needed.

```
18 app.post('/payload', function (req, res) {
19   //verify that the payload is a push from the correct repo
20   //verify repository.name == 'wackcoon-device' or repository.full_name = 'DanielEgan/wackcoon-device'
21   console.log(req.body.pusher.name + ' just pushed to ' + req.body.repository.name);
22
23   console.log('pulling code from GitHub...');
24
25   // reset any changes that have been made locally
26   exec('git -C ~/projects/wackcoon-device reset --hard', execCallback);
27
28   // and ditch any files that have been added locally too
29   exec('git -C ~/projects/wackcoon-device clean -df', execCallback);
30
31   // now pull down the latest
32   exec('git -C ~/projects/wackcoon-device pull -f', execCallback);
33
34   // and npm install with --production
35   exec('npm -C ~/projects/wackcoon-device install --production', execCallback);
36
37   // and run tsc
38   exec('tsc', execCallback);
39 });
40
41 res.sendStatus(200);
42 res.end();
43
44 app.listen(5000, function () {
45   console.log('listening on port 5000');
46 });
47
48 function execCallback(err, stdout, stderr) {
49   if(stdout) console.log(stdout);
50   if(stderr) console.log(stderr);
51 }
52 }
```

Figure 5. Continuous-Deployment-to-a-Raspberry-Pi

Conclusion

This detailed paper has described the procedure, installation and software needed to create the basic capabilities of Raspberry Pi and protection against outside threats from viruses, hackers and even malware.



```
karaf@root()> info
Karaf
  Karaf version      3.0.0
  Karaf home        /x1/apache/test/apache-karaf-3.0.0
  Karaf base        /x1/apache/test/apache-karaf-3.0.0
  OSGi Framework    org.apache.felix.framework - 4.2.1

JVM
  Java Virtual Machine  Java HotSpot(TM) Client VM version 25.0-b04
  Version              1.8.0-ea
  Vendor               Oracle Corporation
  Uptime                1 minute
  Total compile time   25.208 seconds
Threads
  Live threads         35
  Daemon threads      31
  Peak                 36
  Total started        41
Memory
  Current heap size    41,513 kbytes
  Maximum heap size    506,880 kbytes
  Committed heap size 126,848 kbytes
  Pending objects      0
  Garbage collector    Name = 'Copy', Collections = 6, Time = 1.183 seconds
  Garbage collector    Name = 'MarkSweepCompact', Collections = 1, Time = 0.778 seconds
Classes
  Current classes loaded 4,588
  Total classes loaded  4,588
  Total classes unloaded 0
Operating system
  Name                  Linux version 3.2.27+
  Architecture          arm
  Processors            1
karaf@root()>
```

Figure 6. I code by the Sea.

Acknowledgements

This research would not have been possible if committed and dedicated people did not support me in guidance and inspiration every step of the way. I must first acknowledge one of the most phenomenal teachers, Dr. Valerie M. Davis who afforded me this great opportunity. She was outstanding and a major motivator in the execution and implementation of this paper. She taught me every step of the way the outline, procedure and format for writing a scientific paper. This opportunity and her teaching enabled me to believe in myself resulting in confidence coupled with establishing my abilities in the field of science. My grandmother and godmother remained supportive throughout this whole process. They really were the best!

Now last, but not least, Dr. Jesse Bemley and his JEF organization, (Joint Educational Facilities), were outstanding in managing and pushing me to stay focused and on track as I worked toward the completion of my projects. I realize that without his guidance, coupled with Dr. Davis' teaching and high expectations of me, I would have probably faded out and not reached any goal that I had set for this experience.

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Blockchain Governance

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Abstract

The right to participate in governance through voting can only be effective if there are enough mechanisms in place to ensure that the votes are adjudicated equally and transparently. The fairness of the electoral process was placed firmly in the fore-front of the American psyche during the 2000 presidential election, but whether the cause came from intentional malice or unintended failures in technology (Norden & Famighetti 2015) does not belie the fact that the process of voting strives to be both transparent and scientific. The Blockchain governance movement leverages the technological power of distributed ledgers in an attempt to create a transparent voting system based on the science of cryptography and peer-to-peer networks. The technology, developed more for transactions of value—whether it be payment systems or token distribution—has still not been fully applied to governance, specifically voting. Evidence of this can be seen from the Cal Tech/MIT Voting Technology Project’s website, where a search for ‘Blockchain’ returns no entries. However there are increasing movements to digitize governance, whether it be Estonia’s E-Resident program (Running 2015, and Hammersley, 2015) or Republic of Kenya’s E-Citizen portal designed to apply for Government services. The question is why has voting, maybe the most important aspect of governance, been one of the slowest parts of government to be “disrupted” by technology.

We propose a demo-voting project for ICAT 7 participants. Participants in the conference will have the opportunity to receive digital tokens via a web-app which they may then use to vote on matters relevant to the conference.

Keywords: Blockchain, Governance, Cryptography, Ethics

Blockchain Governance Demonstration

We are using a sm360 fingerprint verification module to interface with a laptop for our project. The fingerprint database will either (1) create a private key via a client-side javascript wallet generator for Bitcoin, or will be used to reference the voting database against duplicate entries.

We will need a station for individuals to pick up their voting ballots and then a topic to vote on. The projected audience is everyone at ICAT who wishes to participate.

We will bring all necessary equipment but we might need a printer to print out voting ballots (The number of participants divided by around 4-ballots-per-page).

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Using Raspberry Pi

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Abstract

The Raspberry Pi is a cross between a typical embedded system – like an Arduino – and a desktop computer. The latest model of Raspberry Pi, Raspberry Pi 3 with Broadcom new SoC, BCM2837! This retains the same basic architecture as its predecessors BCM2835 and BCM2836, so all those projects and tutorials which rely on the precise details of the Raspberry Pi hardware will continue to work. The 900MHz 32-bit quad-core ARM Cortex-A7 CPU complex has been replaced by a custom-hardened 1.2GHz 64-bit quad-core ARM Cortex-A53. Combining a 33% increase in clock speed with various architectural enhancements, this provides a 50-60% increase in performance in 32-bit mode versus Raspberry Pi 2, or roughly a factor of ten over the original Raspberry Pi.

Keywords: Raspberry Pi 3, SoC, ARM Cortex - A7, quad-core, embedded system, wireless functionality

Workshop's Outline

The model used in this workshop is a 700MHz ARM11 Core with 512MB of RAM, HDMI and audio outputs, 2 USB ports, an Ethernet jack, and an SD socket with support for up to a 32GB SD card. It is one of the more powerful, cost-effective embedded boards to hit the market.



The Raspberry Pi is a great platform on which to learn Linux and programming. It is also a powerful solution for many “Internet-of-Things” projects, because it is so easy to get connected to the Internet. It can run Python scripts, or even compile programs written in C. It is a full-blown computer! And, of course, it can be used to play games.

Participants of this workshop will:

- Prepare An SD Card
- Prepare The Raspberry Pi
- Install Raspbian
- Setup Raspbian
- Explore Raspbian (File Manager, Terminal, and Web Browser)
- Install Applications

No experience is needed and participants will be provided with all materials needed. Each completed Raspberry Pi will be networked and the resulting LAN will be provided to the university.

Personal Power is Real Power

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Abstract

Personal empowerment involves developing the confidence and strength to set realistic goals and fulfil your potential. Everyone has strengths and weaknesses and a range of skills that are used in everyday situations, but all too often people remain unaware of, or undervalue, their true abilities.

A person aiming for empowerment is able to take control of their life by making positive choices and setting goals. Developing self-awareness, an understanding of your strengths and weaknesses - knowing your own limitations is key to personal empowerment.

Developing personal empowerment usually involves making some fundamental changes in life, which is not always an easy process. The degree of change required will differ from person to person, depending on the individual starting point.

Keywords: empowerment, self awareness

Workshop's Outline

This workshop will allow participants to explore what it means to be empowered. They will discover that there are levels of empowerment. Time will be given to allow individuals to examine their own lives to identify their empowerment level. Tools to enhance empowerment will be discussed. Small group exercises will be conducted to demonstrate the benefits of the tools.

The Benefit of Foresight: INAT 2030

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Abstract

The Appropriate Technology Movement, exemplified by the community of the International Network on Appropriate Technology (INAT) congregating at this 7th International Conference (ICAT), has forever been concerned with this year's focus, sustainable development. Our community, started formation in 2004, have been "bridging theory and practice" in a myriad of disciplines by creating applications to solve problems of access, to clean water, better education, affordable housing, income, information, etc. The objective of this workshop is to go together on a journey to map the changing world around us and explore urgent futures for INAT. "Foresighting" or "futures-thinking" approaches claim to offset short-term thinking, foster innovation, and offer rigorous and systematic analyses of "signals of change," thereby building a community that thinks about possible futures (desirable and not) with the intention of making better decisions today. To help us developing possible scenarios for INAT in 2030, we will use "Alpha INAT 916" or Envision INAT, which is a foresight role-play game designed for this workshop. The first part of the name "Alpha" refers to the game being the first developed plot subjected to editing and restructuring while "916" refers to the date that it was developed, September 2016. We hope to use our collective thinking about our possible "roles" and "futures" to advance our planning and opportunities.

Keywords: Futures Thinking, Foresighting Approaches, Game Theory

Workshop's Outline

The workshop will start by introducing futures thinking approaches, and explore a number of "signals of change" that are relevant to the Appropriate Technology Movement. The process of "Rooting INAT" will use the back-casting approach, and "Envisioning INAT 2030" will use a game specifically developed for this workshop - Alpha INAT 916. The workshop involves group work to explore alternative futures, their paths, and our roles!

In addition to using the futures lens to look at our Network and its futures landscape, we hope that participants will acquire knowledge about the futures thinking approach, and like it enough, to encourage their groups and organizations to use it as part of their tool-set for thinking *outside-the-box*.