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Energy Efficient Mobile Adhoc Network using Raspberry PI

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Abstract*: This paper based on generation of power using wearable technologies from sustainable resources to establish Mobile Adhoc Network communication between multiple nodes using Raspberry pi-3 microprocessor. It mainly focuses on aiding in the search and rescue operations of explorers or mountaineers in case of avalanches or in case of some unfortunate disasters. An advanced routing mechanism called Better Approach to Mobile Adhoc Networking is used to establish communication between the explorers to transfer user location information to the base station.

***Keywords:* Power generation, sustainable resources, transducers, Mobile Adhoc Network and BATMAN.**

I. INTRODUCTION

Even though the rate of accidents in rambling are increased, but the thirst for adventures are never down safety measures plays an important role in it. The energy supplements are lost during trekking. Though it is constantly required, batteries are too heavy to carry around. In order to meet this issue, energy is drawn out from the renewable resources. The power generated is stored in low voltage batteries. It is mostly used for safety of people in groups, during trekking in forest and hill stations. MANET communication is done by raspberry pi and the power generated by the wearable technology is used for it. An advanced routing mechanism is used for the communication of the nodes in the local network for purpose of transfer of basic information. Sub nodes are used to take the information from the individual node to connect it with all other nodes. Due to decentralized network, the information is send to all other nodes. BATMAN is the routing technique used for the transfer of data between the given set of nodes. As per the survey, the major threats faced by the mountain climbers are lack of preparations, negligence by the mountaineer leads to accidents. The surveillance of the trekkers is very tedious due to the signal problem in hill regions. The MANET communication is chosen in order to meet this difficulty.

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The BATMAN routing algorithm is opted in place of LSR. A framework to generate thermoelectric energy by sensors deployed using wearable technologies, which includes self-powered wearable electronics, self-powered sensors and communication equipment [5]. This arrangement is chasing for extreme concentration of light [1]. New idea of Waste-heat recovery was developed which uses thermoelectric power generation, a probable function in the express replace of dissipate-warmth force into electrical control with highest output. It improves the overall efficiency conversion systems with minimal warmth source [2]. A shoe control maker proposes based on a micro prepared piezoelectric polymer transducer, to control power from person stride devoid of touching the user's bearing. This representation generates electrical power for charging an electronic widget from the piezoelectric feeler that is permanent to the individual of the footwear [3].

II. ENERGY EFFICIENT MOBILE ADHOC NETWORK

This model system based on sensors to generate power from renewable resources to empower the Raspberry Pi for MANET communication between nodes to transfer data obtained from compass magnetometer module and pulse rate monitor sensor. In order to reach the goal, the following objectives have been established as shown in Figure 1. Develop an experimental setup; sensors are incorporated on the suit of the trekkers for power generation. Design and develop the communication link between the nodes, MANET communication is opted along with the indulgence of sub nodes incapable of operating in the absence of internet.

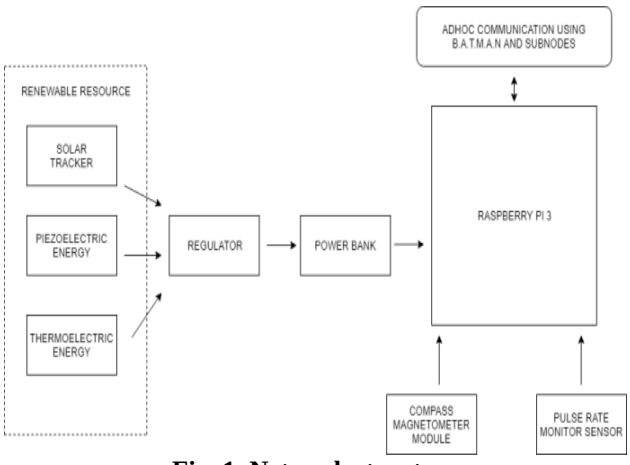

Fig. 1. Network structure

III. HARDWARE DESIGN

A. *Solar panel and dual axis trackers*

Solar panels are used in everyday things like calculators, watches, and flashlights. There are solar powered toys, radios, and MP3 players. There are solar powered cell phones and pagers. Solar panels are sometimes uses to make the electricity to light up. Solar panels can also be used along with power from the grid. It is possible to use less of the grids costly electricity.

Fig. 2. Solar panel

Double axis trackers shown in Figure 3. This double axis tracker will automatically track the sun east to west and adjust the vertical tilt angle to optimize efficiency. Tow axis tracking systems have additional installation, permitting and ongoing maintenance costs. Two axis systems need bigger spaces to place and consequently to receive planning permits is much more difficult for them.

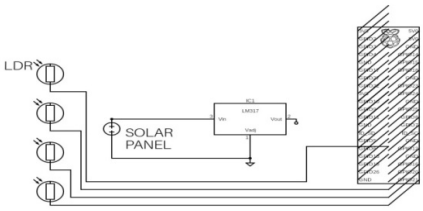

Fig. 3. Solar tracker

B. *piezoelectric transducer*

A piezoelectric transducer gives a higher sensitivity and bandwidth but has a slight departure from linearity and stability. Piezoelectric materials have a high but a finite resistivity. As a result, the charge generated by a change in applied force slowly leaks away, causing the potential difference to reduce eventually to zero, and quartz.

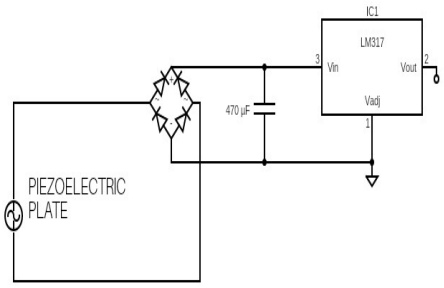

Fig. 4. Piezoelectric transducer

C. *Thermoelectric generator*

Thermoelectric generator consists essentially of a large number of semiconductor thermocouples connected electrically in series and thermally in parallel to form a module and a number of modules are arranged around a beat source to form a generator. Heat is supplied at the hot junction and electric power usually extracted at the cold junctions. Provided a temperature difference can be maintained across the thermo elements of the generator, it will deliver power to an external load. The properties of thermoelectric generators are reliability, ability to operate in hostile environments, absence of moving parts. Thermoelectric generators produce electricity at high currents and low voltages and in order to obtain a useful operating voltage a large number of thermocouples.

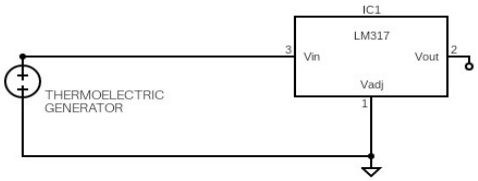

Fig. 5. Thermoelectric generator

D. *Raspberry pi 3 and light dependent resistor*

Raspberry Pi builds on its predecessors with yet another new processor. The first to feature 64-bit rather than 32-bit support the processor is significantly faster than raspberry Pi 2. It is also the first model to get in wireless support featuring a radio capable of connecting to 2.4 GHz Wi -Fi networks and Bluetooth devices. One such structure is shown in Figure 6.

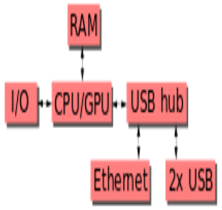

Fig. 6. Hardware structure of Raspberry Pi 3

An LDR (Light dependent resistor) transducer is a light sensitive transducer, which convert light energy into electrical energy. As light falls on the LDR, the resistance of the device decreases. The decreases in the resistance increase the current flowing through the circuit. Light intensity is inversely proportional to the resistance of the device. A typical LDR circuit is shown in the Figure 7.

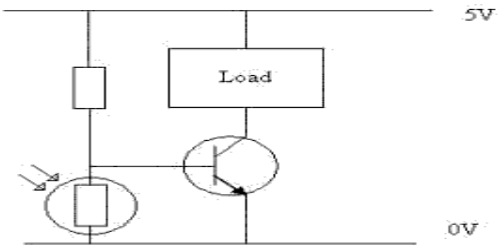

Fig. 7. Light Dependent Resistor

E. hmc5883 3-axis digital compass

HMC5883L, a 3-axis digital compass chip. This chip is packaged onto a module by several companies but almost all of them result in a similar interface. This type of digital compass uses magnetic sensors to measure the earth's magnetic field. The output of these sensors is then made accessible to the outside world through a set of registers that allow the user to set things like the sample rate and continuous or single sampling. The X, Y and Z directions are the output using registers as well. The connections to this chip are straightforward: the device communicates with Raspberry Pi using the I2C bus.

F. pulse rate sensor

Pulse rate sensor is very easy to use. It detects a pulse by measuring the change in the light. This sensor has two portions. LED that is present in the center of the sensor. Below LED, a noise cancellation module is present which cancels noise that can affect the readings. This sensor has three pins. First one is Ground pin, the middle one is Vcc and the last one is analog output pin. The sensor consists of a bright light emitting diode and a Light Detector. the bright light is passes from one side of the finger and the intensity of the reflected light is measured by LDR.

IV. SOFTWARE DESIGN

The software design contains the following modules.

- RASPBIAN STRETCH
- Better Approach To Mobile Adhoc Networking (BATMAN)
- SUBNODES

A. Raspbian stretch

Raspbian is the most popular Linux based operating system for the Raspberry Pi, Raspian is an open source operating system based on Debian, which has been modified specifically for the Raspberry Pi. Rapbian includes customizations that are designed to make the Raspberry Pi easier to use and includes many different software packages out of the box.

B. BATMAN

The Better Approach to Mobile Adhoc Networking (BATMAN) is a steering protocol for multi-hop mobile ad hoc networks which is under expansion by the German "Freifunk" community and planned to exchange the link state defeating protocol - OLSR. BATMAN's crucial point is the regionalization of the familiarity about the best route through the network — no single node has all the data. This technique removes the need to spread substantial concerning network variations to every node in the network. The discrete node only saves material about the "bearing" it received data from and sends its data accordingly. The records get passed on from node to node and packets get individual, energetically created routes. A network of communal intelligence is created.

C. Sub nodes

The Sub knobs development is to be performed consists of turning a series of knobs. The tables used by task consist of a task table and sub task table. The entries in the task table are the high level tasks which decompose into sub-tasks. The network structure is shown in the Figure 8.

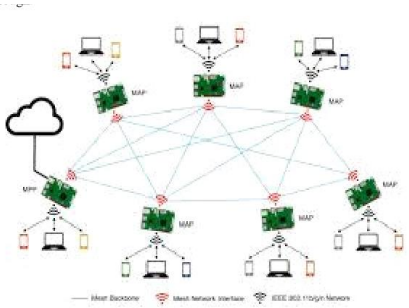

Fig. 8. Network Structural Diagram

V. RESULTS AND DISCUSSION

In order to locate the person and to know his survival probability, the magnetometer, RSSI and Pulse rate sensor readings and the pulse rate sensors output are provided as snapshots. These are approximated values but are more than enough in this scenario and shown in Figure 9.

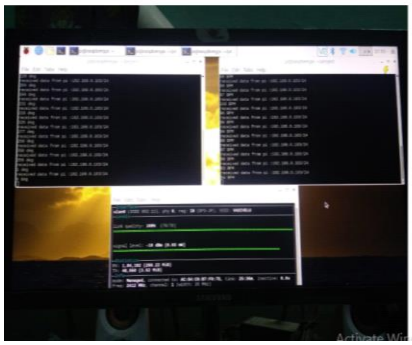

Fig. 9. Magnetometer, RSSI and Pulse rate sensor readings

The Piezoelectric shoes given the Figure 10 absorb the pressure applied by the body and transform it into electricity using the piezoelectric plates present in the sole of the shoe. It then transfers the current to the main circuit where the current is regulated into the storage battery.

Fig. 10. Piezoelectric Shoes

The solar tracker helmet provided in Figure 11 is used to absorb the solar energy produced in the field and sends it to the regulator. It uses multiple Light Dependent Resistor to change the angle of the solar panel to the best position for maximum power by the servo motor set in its base.

Fig. 11. Solar Tracker Helmet

The Thermo electric Jacket is used to absorb the heat produced in the body during the travel and then transfer it into electrical energy using Thermo Electric Generator (TEG), it occurs due to thermal effect due to the heat production and it is transferred to the regulator for regulated output shown in the Figure 12.

Fig. 12. Thermo Electric Jacket

VI. CONCLUSION

This system focuses on increasing the survivability chances of hikers better than the existing human safety procedures. The system may not be perfect still the performance can be further improved by using enhanced sensors. The communication system shall be supported by future technologies for better connectivity at high altitudes.

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