

STUDENTS PAPERS

Paper 37: Session 7 – 7.1

A Low-Cost Mechanical Ventilator with Remote Ventilation Capabilities

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Abstract

The novel coronavirus is a respiratory problem that eventually leads to lung inflammation. The victim's breathing system gets compromised and thus they are put in a mechanical ventilator to aid them in breathing. In Africa there is an acute shortage of such machines. For instance, Kenya has only 500 of these machines with a population of 47 million people. To make matters worse health personnel are also scarce. This paper proposes a low-cost ventilator with remote monitoring capabilities to address these shortages in Kenya and Africa at large. The ventilator is designed to be accessed locally through a monitor or remotely through an android tablet. All information in the ventilator is relayed to the tablet through a relay server. The link is encrypted to prevent unlawful access and also the administrator can set privileges on the user side. This allows one nurse to ventilate multiple patients. Also, if the nurse does not have personal protective equipment, she/he doesn't have to go inside the ICU to respond to a patient and can-do monitoring remotely. This will enable Kenya to achieve both SDG 3 and the big 4 agenda.

Keywords: Ventilator, Encryption, COVID-19, Pandemic. Relay server

Paper 38: Session 7 – 7.2

A vision for Africa: An Integration of Clean Environment and Clean Energy

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Abstract

This paper covers an overview on the future of our energy sources in Africa focusing on an idea of a possible solution to improve solid waste management in our major cities by taking advantage of the waste energy (heat) from power plants/energy intensive industries hence more sustainable cities. Major sources of energy are hydro, geothermal, solar, wind and fossil fuels. The focus of geothermal and thermal power plants has been production of electricity only and heat energy as a by-product. For the heat escaping from cooling towers/flue gases, we suggest an economical approach of harnessing this excess heat for use in generation of steam for use in gasification process. Gasification is an effective thermal principle that uses municipal and industrial waste as the main raw materials for electricity production. For solar, wind and tidal energy sources, which fluctuate; the system can be modified to enable harvesting of excess electricity produced during peak time. This can be stored in large scale heat pumps and thermal storage facilities for use in electricity production by gasification to supplement the main energy sources at times of low production. This will be a boost to the electricity supply on the national grid; lead to effective utilization of waste energy and will also be an effective measure to contain solid waste opposed to the landfill method which is popular in Africa

Keywords: gasification, solid waste management, production of electricity

Paper 39: Session 7 – 7.3

Better Approach to Marginalized Area Networks (B.A.T.M.A.N.)

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Abstract

According to the Kenya National Census 2019, only one in five Kenyans has access to the internet. In July 2016, the UN declared access to the internet to be a human right. Yet the digital divide between the developed world and the global “south” has become even starker in the midst of the pandemic. Information saves lives and to have the internet is to have access to a lifesaver. Realistically though, telcos have barely any incentive to deploy telecommunication infrastructure in rural areas largely due to unfavourable market scenarios. However, alternative network deployments coupled with innovative engineering can ensure affordable and accessible internet for the marginalized communities. This paper gives insights, examples and a path to action by engineers for the community as we engineer a post COVID-19 future.

Keywords: Post COVID-19, alternative network deployments, connectivity, SDGs

Paper 40: Session 7 – 7.4

Runoff Estimation for Nzoia Basin Using NASA’s Geos-5 Satellite Data

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Abstract

Climate resilience defines the capacity to anticipate, prepare for and respond to disturbances, hazardous events or trends related to climate. With the climate fluctuating at the present era, it makes sense to constantly seek to improve our climate change resilience. This involves researching into how the weather develops climate-related risks, and taking steps aimed at coping with these risks. In Kenya, flooding is the most acute event associated with climate change resilience. Flooding occurs due to excessive runoff from a catchment area. Therefore, identifying watersheds and studying their runoff characteristics would provide valuable information to use in improving our climate change resilience. Nzoia basin exhibits temporal and spatial scarcity of rainfall and temperature data available; both for satellite and observed data. Data from rain gauge networks is insufficient at a temporal scale, and would pose challenges when used in runoff estimation. National Aeronautics and Space Administration (NASA) manages the Goddard Earth Observing System model version 5 (GEOS-5) satellites. Satellites by nature are however poor on a spatial scale and therefore need area-specific calibration and validation due to the indirect nature of radiation measurements. This study aimed at improving data available from GEOS-5 satellite for use in runoff studies. By carrying out statistical analyses on temperature and rainfall data from the satellite, it is possible to calibrate this data and analyze its effectiveness in runoff estimation. For NAM mike-11 model, use of satellite data to estimate runoff led to gross overestimation when used in determination of discharge. R-squared between runoff estimated from satellite data and data from observed data was 0.6 for daily data. Calibration of GEOS-5 data led to an r-square coefficient of about 0.9. This was a reasonable improvement, and proved the feasibility of the study.

Keywords: Climate, Runoff, Temporal, Spatial, NASA, GEOS-5, Calibration.

Paper 41: Session 7 – 7.5

Application of Internet of Things in Improving Energy Efficiency and in Smart Grids

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Abstract

Energy is one the biggest game changers in an economy. Energy efficiency and energy cost are the biggest influencers as many industries and homes appreciate energy saving techniques and more secure electric equipment. Application of internet of things in buildings and production of energy will help reduce energy costs. The paper will discuss ways in which institutions and households can save energy. This will help the government in planning in terms of demand of energy and energy investments. The information or data collected using IoT sensors will help in seeing where energy consumption is maximum, where energy is wasted and also help in future budgeting. The application of internet of things use in the energy sector will influence smart cities and

infrastructure and foster the 4th industrial Revolution in Kenya. It will also help in climate change resilience. The project involves using sensors to collect data from home appliances and ensure communication with the other systems, gather data and the data is analyzed.

Keywords: Energy efficiency, Internet of Things, Data, Sensors, Smart Grids

Paper 42: Session 7 – 7.6

Sustainable Transportation: Use of Intelligent Transport Systems

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Abstract

In a fast-paced urbanized culture, sustainable transportation still remains a major challenge. Quick and smooth mobility of people and goods with the possibility of regulating traffic congestion is important for every public transportation user. Urban population in developing nations like Kenya is expected to double by the year 2050 and balancing supply and demand of the urban transport system will be a major issue. This paper aims to review different intelligent transport systems that can be used to reduce the traffic congestion in Nairobi. This would be done by analyzing historical data to gain performance insights and understand the behavior of traffic at intersections and traffic lanes. Using a software this data would then be stored and co-analyzed with real time data to predict traffic volumes and traffic flow. This data obtained would then be used to control traffic signal's timing based on the changing patterns of vehicles arriving at an intersection. Use of Active Traffic Management to monitor and adjust roadway operations over time can ensure dynamic strategies are deployed to optimize performance of traffic operations and enhance safety. If policymakers and legislators establish clear goals, link them to regulatory frameworks with elements of transport planning they can ensure that this new mobility will improve access to new opportunities and development. Efficient transportation will therefore ensure sustainable development of cities.

Keywords: Intelligent Transport System, Sustainable Transportation, Traffic Congestion, Smooth mobility, Active Traffic Management.

Paper 43: Session 7 – 7.7

Engineering a Green Future

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Abstract

The COVID-19 pandemic has been a great awakening factor to show us that without stable systems in place, lack of access to a steady income could impede access to funds for paying for basic amenities like electricity. In this digital age, access to electricity and the internet is pivotal in virtual learning programs for children and in setting up online businesses. This is why we need to put in place affordable off grid alternatives for access to energy in line with SDG 7 that focuses on the access to sources of energy that do not degrade the environment. To solve this problem, biomass briquettes made from readily available waste farm products and charcoal dust can be used as a fuel to run steam turbines that can be used to generate electricity for low income households. This would be a good alternative for wood and coal since its environmental impact is minimal. Biomass briquettes also have a higher calorific value and burn for longer than charcoal fuels. The main focus of this paper is to review how this briquette technology can be integrated into the production of electricity in rural areas that aren't connected to the national grid.

Keywords: Briquettes, electricity, steam turbines