UNIVERSITY OF DAR ES SALAAM

UDSM Researchers Comes with an Inspiring ICT-based Solution to Improve Road Safety

The Campus College of Information and Communication Technologies (CoICT) of the University of Dar es Salaam was established to strengthen, improve, and advance ICT related development studies and trainings in the country and beyond. Hence, as a core component of University education, CoICT was meant to intensify research and innovations that would address pressing challenges facing our country through the potentials of ICT solutions. CoICT campus is located at Bamaga near TBC in a complex which was previosily a staff training college for Tanzania Postal and Telecommunication Cooperation: for some reasons it is sometimes referred to as Kijitonyama Campus. As of today, CoICT has engaged in a number of research projects in various sectors like education, water, health, and agriculture and some of these initiatives have crossed our borders. For example, CoICT researchers are supporting other African countries to implement ICT based solutions to improve health information systems (HIS) and they are participating in facilitating international training-workshops on HIS conducted in different African countries and beyond. This article aims to explain a research project undertaken by CoICT to improve road safety through the use of ICT solutions of which one of the products is an *Integrated Road Safety Management Information System* to improve road safety in Tanzania.

Some of the horrible road accidents in Tanzania (Source: Glob Publisher & other websites)

Road accidents are among major challenges facing our country. We see and hear about them every day in different parts of the country and some of them are catastrophic and cause serious damage to life and properties. Road accidents present health, social, economic and development challenges and they are listed among the leading causes of injuries, disabilities and deaths as it is the case with infectious diseases like malaria, TB, and HIV/AIDS. Road accidents are caused by many things but the common ones in our country are: inadequate road infrastructures that do not meet safety standards, removal or lack of adequate road signs, unqualified motor vehicles, and factors associated with human behaviours for road users. Of all these, researches show that road offences associated with road users' behaviours account for more than 80% of all accidents. Among them are drunkenness, drowsy, fatigue, sleepy or impaired drivers; disregarding of road signs like speed limit, sharp corners, traffic lights, and pedestrians crossings; impatiencet, recklessness, competitive and aggressive driving; drivers using cell phones and drawing attention to other distractive activities; ignoring other road users, overtaking recklessly, and driving on foot path. Researches have shown that the behavior of road users can most effectively be changed by effective and consistent enforncement of road traffic regulations than heft increases in fines. Another factor which has recently gone beyond control is the tendency of motorcyclists and trycyclists to disregard all traffic laws.

In addition to enforcement efforts of road traffic act and associated regulations by the police force, there has been a number of educational programmes to improve road safety mostly focusing in

changing road users' behaviours. However, road safety is still alarming problem and accidents are on raise and it calls for more multifaceted innovative and scientific approaches to address the problem at least for some degree. Factors contributing to increasing number of road accidents are many and tackling them requires reliable information system base that connects different players/stakeholders. Absence of information system infrastructure to connect all actors participating in road safety management present a serious concern both for enforcement and regulatory undertakings. There are a number of government authorities responsible for road safety like TRA, SUMATRA, Police Force, Fire Brigade, TANROAD, Local Governments, TAMESA, Ministry of Home Affairs and Ministry of Works and Communication. Each authority discharges its functions independently with limited interactions with the rest, if any. There is no a shared information base to inform their functions and the independently existing ones are not integrated/linked to enable them share information. This is major challenge facing the multifaceted nature of road safety management which requires participation and interaction of multiple stakeholders including road users. The existing setting has led to data redundancy and duplication of efforts in collecting related information by various authorities which could have otherwise been shared. When one authority requires information from another to make informed decisions, the process is complex, tedious, and time consuming. For those with ICT-based systems, each actor stores and analyses data relevant to its functions independently with little or no attention to the needs of the related others. Together with some technical glitches surrounding the development and implementation of systems with silos designs, the problem is intensified by the absence of policies and legal frameworks to necessitate the use of electronic systems for road safety management and for its use as evidence in courts of law. Apart from speed cameras records which are recognized by law as evidence in legal processing, there is no legal provisions for the use of electronics systems as evidence during court cases. This tells why Tanzania does not have reliable electronic/ICT-based information systems for enforcement of road safety regulations. Those already deployed like the current offences recording and penal system, are not guided by any institutionalized technical standards to ensure security, confidentiality and quality. Most of the existing electronic systems are commercially driven and as a results their purpose of use and technical specifications comes from vendors and not the consumers/users. In this kind of a situation, users' specific needs and the system's nature of use are rarely prioritized and this is why integrated and interoperable architecture is missing since the vendors do not take that as a necessary requirement. Technically speaking, this kind of a design is a threat to the software market as it limits the need for systems developed with silos mentality.

The iROAD system

Researchers at CoICT lead by Prof Nerey Mvungi, Dr. Honest Kimaro, Prof. Herald Kundaeli, Dr. Hamisi Ndetabura, and Mathew Mndeme, are undertaking a scientific research on how authorities responsible with road safety management can leverage on the potential of ICT-based systems in addressing safety challenges. This research project is supported by TCRA in its efforts to advance ICT researches and innovations in the country. Since the inception of this study over two years ago, CoICT researchers have consulted a number of stakeholders including all relevant government authorities/institutions involved with transportation and road safety management, the focus being to understand existing information systems and those in pipeline for implementation. Researchers have established relationships among these systems and their challenges that can be addressed through ICT innovative solutions. One of the immediate outputs to the study is the development of an ***Integrated Road Safety Management System,*** Christianised as **iROAD**.

The iROAD system is developed by systems developers under the road safety research team and its design has taken into account the context of Tanzania environment, usage, and safety regulations of our road systems. Development of iROAD aims to achieve an integrated design with ability of link and

share information that will: (1) strengthen enforcement of road safety regulations (2) to reduce death, injuries and disabilities caused by road accidents (3) safe guide road infrastructure and properties exposed to road accidents (4) build a platform where stakeholders can share information and strengthen their interactions (5) build an open platform to engage community to participate in enforcement of road safety regulations (6) provide evidence in penalizing offenders and make road users more sensible (7) be used for verifying documents and registrations of motor vehicles (8) minimizing time and simply the process of reporting and responding to accidents (9) inform policy and administration activities.

Design of iROAD system

Most of what was envisaged of iROAD has so far being achieved. The system modular design serves the information needs of various players and it has a built-in interoperable capabilities to accommodate data from other related systems. The design allow data to be pooled by various players from the central/shared database and at the same time, each component works as stand alone. The system can be accessed through various devices like mobile phones, desktop computers, tablets, and laptops. It provides a web-based interface with front and a mirror servers accessible though the address www.roadsafety.go.tz . Authorized mobile-phone users can have full or selected functionalities such as: police officers and other users reporting accidents and violations; police officer verify drivers' license and vehicle registration onsite; the ability of the person reporting to upload picture and/or video clips; automatic capturing accident location using GIS technology; bystander or passenger reporting accidents and violations; and mapping nearby police stations, hospitals, etc.

iROAD changes enforcement of road traffic regulation

The integrated feature is more visible on how the system makes information available to various players in a blinking of an eye. Once an accident is reported by a police officer, bystander or passenger, the information is made available to nearby police stations, hospitals, fire brigade, and ambulatory services. In this way, necessary actions can be taken to serve lives and properties within the minimum time possible. The reporting has deviated from the traditional SMS or voice mail to GIS based system

using mobiles phones which are readiliy available to efforcement officers and ordinary citizen. Hence, widespread deployment is made feasible in a short period. A traffic police on site can view the validity and registration of vehicles and keep track of penalties and payments using mobile devices. The same, can access records of previous court charges and decisions to a given driver. The system make it possible to generate various reports through its powerful data analytics component and makes it easier for various agencies to communicate and share information with little control of the bureaucratic manual system. Hence, it provides immense portential to support policy makers and effective efforcement of road traffic laws and regulations. The system produces timely reports that can inform court proceedings hence reducing piling of cases waiting for hearing or decisions. iROAD comes as an innovative solution to trigger action by emergency response teams during accidents and those in management positions and provides consumable information to remind road users traffic regulation and for education purposes. Different from the current system, iROAD provide a platform for engaging community to participate in strengthening road safety.

Police officers involved in iROAD userbility testing which will do away with paper based systems

iROAD has already gone through a successful system and functional testing stage and the process for piloting it in a real working informant is in progress. As the road safety enforcement agency, the police force is engaged in this process to see how the system suits their information needs and that of other related authorities. CoICT researchers are still brainstorming to advance the system design once piloting starts. They are determined to invite other stakeholders who will be ready to inject more resources and expertise to the research project and include other modules that will make it possible for iROAD to be connected to road safety cameras to capture ALL offences automatically in all setuations in the absence of traffic police officers. The development of iROAD is locally driven and funded and leveraging in our local ICT experts and the technology available to our settings. In this way it promises to meet local needs and ensure sustainability without dependency external forces and technologies beyond our reach. The system has been displayed in a number of research exhibitions in and outside the country and this year it was one of the outstanding research projects within CoICT that received university-wide recognition (http://coict.udsm.ac.tz).

It is highly recommended that information systems should be designed and developed by local experts and using technologies available in the environment of use. The thinking of a system designer should march the context of system use and be driven by the needs and culture of the intended users. iROAD has not only taped from this experience in its design and development but, also taken into account the nature of our road infrastructure, the legal framework of road traffic system, and the fact that regulations are changing from time to time hence the need for reliable and readily available technical capacity to accommodate them. Reliable technical support to system users is of paramount importance for effective information system and this is made possible when experts, technology, and necessary facilities are locally available when needed. This aspect ensures users' satisfaction, saves time, and minimize operational cost than other existing models. Researches show that most of the ICT based

systems in developing countries like Tanzania fail to serve the intended needs and produce the unintended results due to lack of local touch in their design, development process, and needs

Left: *Dr.Kimaro and Prof. Mvungi explaining how iROAD system works to Former President Kikwete during a research exhibition event at the Mwalimu Nyerere International Conference Centre in DSM*

Right: *Some of the CoICT researchers in a group photo after winning the first price in one of the inter-colleges research exhibition which took place recently at the UDSM JK Nyerere Mlimani campus*

assessments. In the end, a lot of resources are waste and the evidence of the technology to bring change is made questionable.

Prioritising local needs, experts, and technologies in addressing challenges through research in our high learning institutions, helps the nation to use relatively little resources to acquire relevant solutions. It creates an environment where researchers practice what they teach and realise the practicability of theoretical knowledge shared to students. In the same way, this practice optimizes the use of available resources like laboratory and intensifying research and innovations both to lecturers and students. Knowledge is transferred from individual or small group of people to many and hence building a strong knowledge base to the nation and generations to come. Technical solutions that originates from local needs and leverage in local skills and technology has all the possibility of being successful and sustainable. For ages not, this has been the common practice to most of the economic powerhouses in the world. Tanzania as a country is not there yet but we are not late to reposition ourselves toward that direction.

CoICT needs close collaboration from the government and authorities responsible for road safety management to pilot the system and to expand this research to tap on the promise of its potentials. It is significant to point out that the system can be changed to suit other applications as shall be required by the community, the government or its institutions. As a campus college of a public university, CoICT can potentially works more effectively with the government in providing quality services to the public and address a number of challenges though the use ICT, road safety management being one of them. In this way, the investment that has been done in establishing CoICT, setting up relevant infrastructures, and producing qualified researchers, will be more meaningful to the Tanzanian community and at the same time encouraging research undertakings, innovations, and improve advanced ICT trainings. Our economic and development agenda will be more promising when driven by knowledge and researches.

In summary, consistent and continuous enforcement of road traffic regulations is the most important factor to address the disregard of traffic regulations and laws and hence reduced accidents and fatalities than increasing fines alone. The developed ICT system can help the police force/government to address the accidents nightmare. It is offering a comprehensive system using PCs, camera and mobile phones.

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