2017 2nd IEEE International Conference On Recent Trends In Electronics Information & Communication Technology (RTEICT), May 19-20, 2017, India

Design and Implementation of Automatic Medicine Dispensing machine

Mahaveer Penna,
Dept. of E&CE, Sri Venkateshwara College of Engineering, Bengaluru,
mahaveer6017@gmail.com

Dankan V Gowda,
Dept. of E&CE, Sri Venkateshwara College of Engineering, Bengaluru,
dankanies@gmail.com

Jijesh J J,
Dept. of E&CE, Sri Venkateshwara College of Engineering, Bengaluru,
jijesh_jj@yahoo.co.in

Shivashankar,
Dept. of E&CE, Sri Venkateshwara College of Engineering, Bengaluru,
chenduss123@gmail.com

Abstract—**Medicine distribution for the people in the remote tribal areas is finding tedious task for the Government's, the Automatic medicine dispensing machine can aid to resolve the above mentioned requirement. This machine is equipped with some basic and emergency medication and can be refilled. It is a kind of computerized medicine storage system which can be easily accessed by the people in emergency without approaching any pharmacy, this machine can be easy installed in the remote areas like long highways, desert areas, remote tribal areas and rural areas. It is a microcontroller and motor based system to dispense the medicines when accessed by the user through an input event, the data pertaining to the medicine storage can be ascertained from the remote area and based on that information refilling the machine can be easily done. Basic human parameters like Blood pressure (BP), Temperature can also be tested through this machine and the specified medicine will be dispensed based on the patient condition.**

***Keywords*—Automatic Dispensing Machine (ADM), Pills, Microcontroller, Arduino, IoT**

I. INTRODUCTION

Automatic Medicine dispensing machine aims to provide healthcare for the people leaving in the remote tribal areas, but the scope of it's implementation can be extended to many physical locations where no pharmacy is existing, anyone can access this system by providing input of their choice through keypad or any other input device and can avail medicines through automatic microcontroller based motor system, medicines can also be dispensed based on the condition of the user like by checking the temperature, BP and others. Medicines were dispensed under a secured environment like dispensing limited count of medicines to the user. Medicines can be refilled occasionally without checking the storage slot,special sensors installed in this system will be giving the information about the medicine availability within it and giving information to the concern authority through the communication mechanism involved in it.

The input peripheral can be of any sensor and a keypad where the system is giving customized provision for the patients to give their details for authentication. Patients can avail medicines based on their health condition through the sensing mechanism and the authentication process through the keypad. Certain medicines for stomach related issues can be dispensed through keypad accessing upon further customizing. The Arduino microcontroller was chosen as the primary component for the system in order to process the input and provides the output through the motor mechanism. The intelligent nature for the complete system can be achieved by programming the microcontroller, all the activities of sensing, processing, running the motors and dispensing the medicines were handled by programming the microcontroller. Display provision was facilitated in this system for the user convenience. The functioning of this system is quite simple first, user whom need to undergo with the authentication process, the data given by the user like username and password were stored in the system and can be used for further authentication, a display system can helps the user to undergo this process.

II. RELATED WORK

Liuet.al. in "Design and Application for Automated Medicine Depositing and Dispensing System of Pharmacy" 2008 [1] discussed the design of medicine depositing and dispensing system with a mechanical structure and discussed about the hardware of the control system and its analysis.

Wen and Xin Long in [2] discussed about the design of vending machine based on short massage payment with using the M68HC11 and GPRS module MC35. They designed a structure of vending machine using the aspects of hardware ideas of bus conversion interface, software protocol rules based on the AT commands. The authors of [3] proposes a design of medication reminder machine, the methodology proposed in this paper inspired to establish an auto reminder mechanism to the organizers when the medicines in the slot were gone empty.

Karat and Jackrit in "A Study and Development on Robotic Drug Storaging and Dispensing System in Drug Logistics for A Mid-Sized Hospital" 2014 [4] proposed a method of distributing medicines by using Intelligent system equipped with Auto guided vehicles and robot dispensing mechanism.

978-1-5090-3704-9/17/$31.00 © 2017 IEEE

Niswar et al in "Performance evaluation of ZigBee-based wireless sensor network for monitoring patient's pulse status" 2013 [5] came to a conclusion that wireless sensor networks were vastly deployed for health care purpose, they developed a wireless sensor network which can ascertain the patient's pulse from the remote area which is the primary objective of our proposal. They deployed a sensor into the patient's arm, which constitutes microcontroller, zigbee and pulse sensor, this system well send the tracked patient's pulse information to the supervisor node through Zigbee.

Mohammed Y. Tarnini in "Fast and Cheap Stepper Motor Drive" 2015 [6] focused on controlling uni polar stepper motor by a decoder initiated by 555 timer, which can allow motor to rotate in both the directions.

Islam et al [7] proposed that the IoT revolution can be solving the issues related to the health care industry and they discussed the survey on IoT based health care technologies.

III.BLOCK DIAGRAM

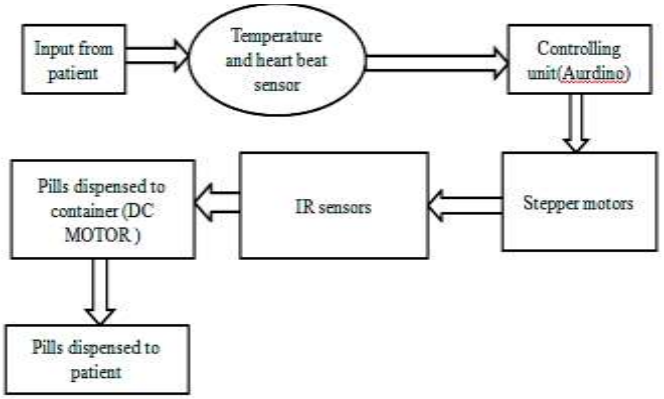

Fig 1: Block diagram of the system

Figure 1 show the system block diagram, in which it explains the complete flow of functionality, and the interfacing units of all the modules to the controller was depicted in the figure 2.

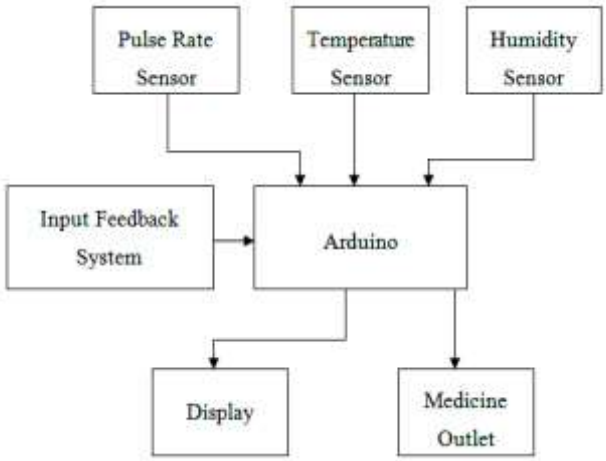

Fig 2: Functional Diagram

The system is loaded with the medicines and will be dispensed upon the request of the users, the total system functioning will be handled by the microcontroller interfaced with the sensors which they detect the ailment and the motors to dispense the medicine. The information related to the storage data of the medicines will be send to the organizer through GSM AT commands, the user interaction can be done through LCD and Keypad console. System is providing certain privileges to the patient to choose the required medicine. Information about the patient and the usage of the medicines by the patient will be tracked and the corresponding data will be stored for further reference, the main entity is the microcontroller which is interfacing different sensors to detect the ailments like fever, BP and so on of the patients, sensors are specific for the ailments.

IV.METHODOLOGY

Methodology involves the procedure to accomplish the design of the proposed system. Initially the various sensors were analyzed to justify the requirements mentioned in the proposal. Various sensors were configured like pulse rate sensor for checking the heart beat, temperature sensor for checking the fever. The lcd display console along with keypad and the sensor were systematically interfaced with the microcontroller as shown in the figure 2. The sensor working with optical phenomenon with infrared light emitter and phototransistor, the sensor gets functioned by pulling enable pin high will turn the IR emitter LED on. The output of the sensor passed through RC high pass filter where DC component is removed later followed by Low pass filter of the Opamp circuit [8]. The voltage gain value for AC component

$$\text{Voltage Gain } (A_v) = (V_{out}/V_{in}) \qquad (1)$$
$$= A_F/\sqrt{(1+(f/f_c)^2}$$

A_F = the pass band gain of the filter, (1 + R2/R1)

f = the frequency of the input signal in Hertz, (Hz)

fc = the cut-off frequency in Hertz, (Hz) = (1/2Πrc)

The other type of sensor which measures the temperature of the user preferably LM35 temperature sensor made by National semiconductor, LM35 is highly precise, linear and wide range device, the output voltage of its is linearly proportional to Celsius temperature. The temperature equation measured with LM35 [9].

$$T = Vout/K_t \qquad (2)$$

T— temperature, °C

Vout—temperature multimeter's output voltage, mV

Kt—Linear scale factor, adopt 10.0 mV /°C.

The output of the LM35 with analog signal and few microcontrollers will not be having the provision to take analog signal directly, Arduino converts analog to digital through its inbuilt 10 bit ADC [10]. The other side of the project includes interfacing of the stepper motor and the DC motors with the Arduino for medicine dispensing.

The stepper motor with the shaft and mounted with the series of magnets controlled by electromagnetic coils making the

stepper motor to rotate to move the medicines in order to place near the vent when a specific medicine is chosen with precise steps of specific step angle. Two types of stepper motors one is unipolar type and the other is bipolar, the digital pins of the microcontroller feed the stepper motor, the current and voltage expressions related to Stepper motor phase windings as shown below.

$$e_A = -K_m \omega \sin(N_r \theta) \quad (3)$$

$$e_B = K_m \omega \cos(N_r \theta) \quad (4)$$

$$\frac{diA}{dt} = (Va - Ria - ea)/L \quad (5)$$

eA and eB are the back emfs induced in the A and B phase windings, iA and iB are the A and B phase winding currents and vA and vB are the A and B phase winding voltages, these parameters initiates the analysis of step angle measurement.

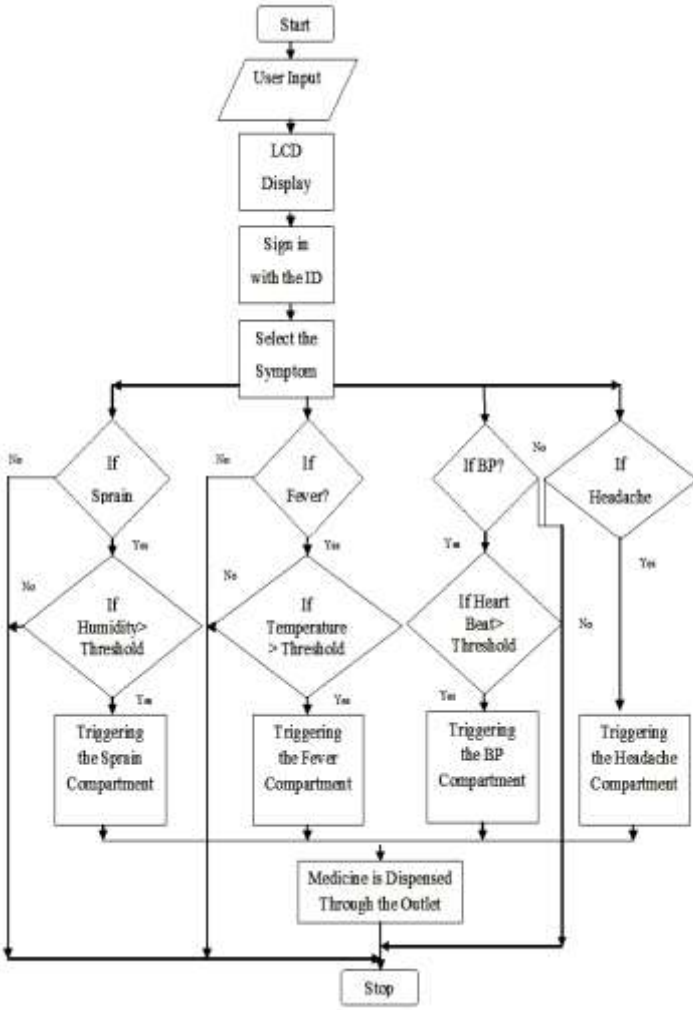

Fig 3: Functionality Flowchart

The other objective of the proposal include giving the information about the status of the medicines availability in the stock to the organizer in the remote location, which gone through the implementation process by programming the microcontroller using AT commands to initiate the GSM module which triggers a SMS. This method of communicating to the remote location replaced with IoT based mechanism, as the LCD display interfacing plays as the prominent module of the project in which the LCD display and the keyboard setup is left as the user console. A 20x4 LCD display constitutes two registers for commands and data was chosen to interface with the microcontroller, the interfacing was carried out based on the specifications. The 20x4 LCD interfacing with the Arduino implemented based on the specifications, the 20x4 indicates 20 columns and 4 rows of the data presentation, every LCD had specific pins for power supply, Read –Write operation and for data interaction pins with other devices. The data bus lines of the LCD are digital with high or low. The LCD related programming package inheritance in the code makes the use of LCD in the application. Several operations like Autoscroll, Blink, Cursor, Display, Set Cursorand Text direction were involved in the LCD application [11]

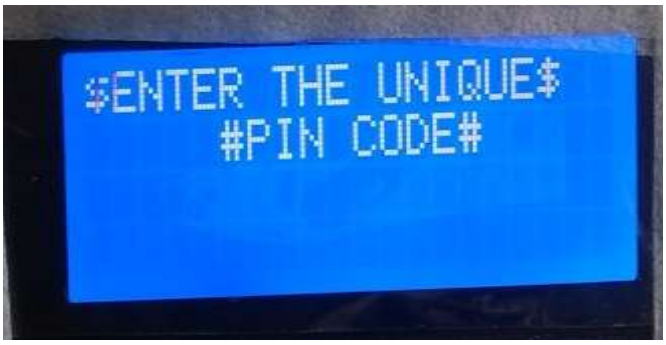

Fig 4: Console Screen of the Application

A 4 x4 keypad interfaced with the microcontroller, the keypad module contains 4 pins for rows and 4 pins for columns which connects to the microcontroller, the following line of code creates the keypad.

1. Keypad kp
2. d = Keypad(makeKeymap(keys), rowPins, colPins, ROWS, COLS);
3. char key = kpd.getKey(); [12].

The complete implementation of the application based on the specified values of every module according to the manufacturer, the parametric values related to every module was utilized in the design process, some of them include.

TABLE I: Electrical Characteristics of Humidity Sensor

	Conditions	Minimum	Typical	Maximum
Power Supply	DC	3V	5V	5.5V
Current Supply	Measuring	0.5mA		2.5mA
	Average	0.2mA		1mA
	Standby	100uA		150uA
Sampling period	Second	1		

And the Table 2 gives technical specification of the DHT11 humidity sensor.

TABLE II: Technical specification of DHT11 Humidity Sensor

Item	Measurement Range	Humidity Accuracy	Temperature Accuracy	Resolution	Package
DHT11	20-90%RH 0-50°C	±5%RH	±2°C	1	4 Pin Single Row

The specifications of the other modules were considered same as the humidity sensor.

V.RESULTS

Fig 5: Automatic Medicine Dispensing Machine

Fig 5 represents the complete hardware entity of the application with the motors and microcontroller setup packed inside. The medicine dispensing got accomplishment based on the requirement of the user, the screen console related to the user authentication with respect to the age as shown below.

Fig 6: LCD console for Authentication

The user options for the medicine selection displayed on the screen and the entry through the keypad, figure 7 depicts the various screen options for the users.

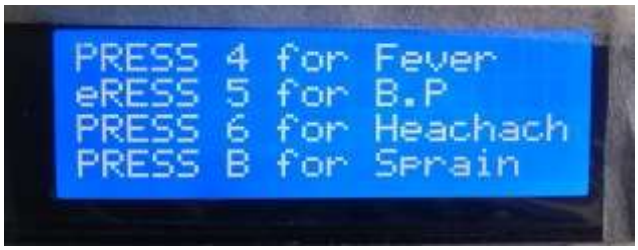

Fig 7: Options for the User.

The framed objectives were justified in the process of implementing this application and the machine usage analysis were performed for this application to improve the health care in a village nearby. The results with respect to the health care improvement were fascinating after installing this device in a village, the screen analysis data as follows.

Data collected on an Average per day in a small village considering the basic ailments. The data is analysed for two cases before and after installation of the proposed device, the percentage of health care improvement was portrayed after installation, and from the tables mentioned below states that health care improvement raised from 5 people medical access to 17 people medical access after the installation of the device which is raise from 25% to 85% of health care improvement. The results show almost 250% of health care improvement with this device, eventually raising the economic growth of that village over span of years.

Before Installation:

TABLE III: Data collected before installing the device

Total Population of Village	**No. of Adults**	**No. of Children**	**No of People fall in sick on an Average per day**	**No of People with no medication and no access to doctor**	**Percentage of Health care access**
147	122	25	20	15	25%

After Installation:

TABLE IV: Data collected after installing the device.

Total Population of Village	**No. of Adults**	**No. of Children**	**No of People fall in sick on an Average per day**	**No of People utilizing the device.**	**Percentage of health care**
147	122	25	20	17	85%

The healthcare improvement portrayed graphically in the figure 8.

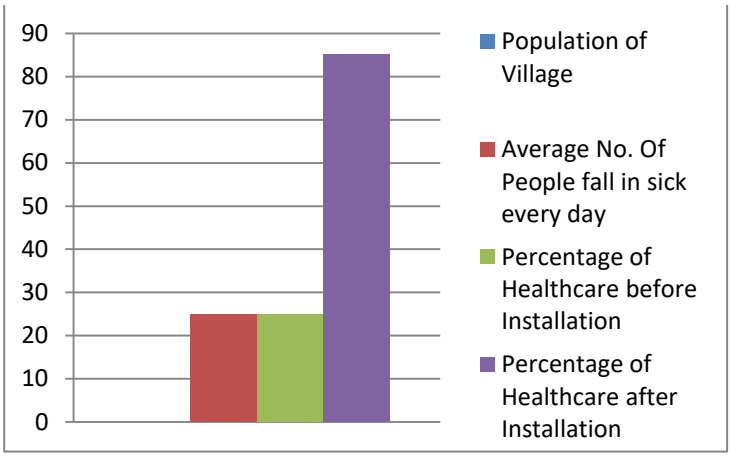

Fig 8: Graphical Representation of the analysed data.

The health care improvement graph portrayed below

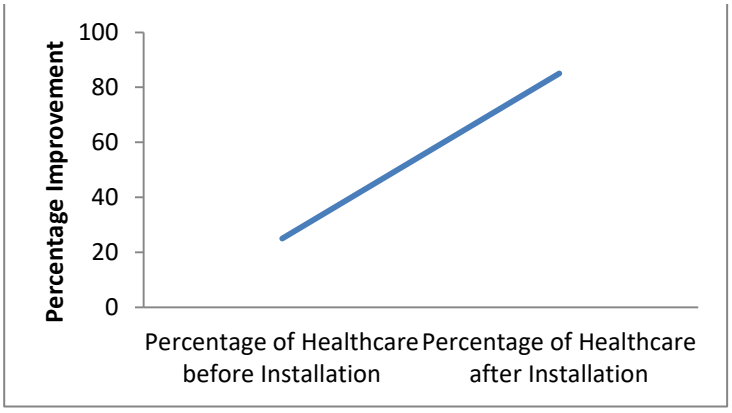

Fig 9: Graphical Representation of Healthcare Improvement

CONCLUSION AND FUTURE WORK

The proposal Automatic Medicine dispensing machine designed and implemented to improve the health care in the remote rural areas by serving the patients for their basic ailments like fever, headache, and so on, the design of this system using cutting edge technical aspects like embedded systems and Arduino accomplished fruitful results in the improvement of the healthcare by dispensing the required medicine for the patients upon their request through keypad interface, and the healthcare improved data was justified with a simple experimentation. The future update for the existing system include incorporating IoT, which improvise the automation and controlling ability of the system through a website or a mobile application, finally the Automatic medical dispensing machine to be set as the future trend to improve the health of remote rural population.

REFERENCES

[1]. Xiangquan, Liu, et al. "Design and application for automated medicine depositing and dispensing system of pharmacy." *Computer Science and Information Technology, 2008.ICCSIT'08.International Conference on*.IEEE, 2008.

[2]. Zhang, Wen, and Xin Long Zhang. "Design and Implementation of automatic vending machine Based on the short massage payment." *Wireless Communications Networking and Mobile Computing (WiCOM), 2010 6th International Conference on*. IEEE, 2010.

[3]. Bai, Ying-Wen, and Ting-HsuanKuo. "Medication adherence by using a hybrid automatic reminder machine." *Consumer Electronics (ICCE), 2016 IEEE International Conference on*.IEEE, 2016.

[4]. Thanaboonkong, Karat, and JackritSuthakorn. "A study and development on robotic drug storaging and dispensing system in drug logistics for a mid-sized hospital." *Robotics and Biomimetics (ROBIO), 2014 IEEE International Conference on*.IEEE, 2014.

[5]. Niswar, Muhammad, et al. "Performance evaluation of ZigBee-based wireless sensor network for monitoring patients' pulse status." (2013).

[6]. Tarnini, Mohamed Y. "Fast and cheap stepper motor drive." *Renewable Energy Research and Applications (ICRERA), 2015 International Conference on*.IEEE, 2015.

[7]. Islam, SM Riazul, et al. "The internet of things for health care: a comprehensive survey." *IEEE Access* 3 (2015): 678-708.

[8]. Pulse, Introducing Easy. "A DIY photoplethysmographic sensor for measuring heart rate." (2012).

[9]. Liu, Cuihong, et al. "The application of soil temperature measurement by LM35 temperature sensors." *Electronic and Mechanical Engineering and Information Technology (EMEIT), 2011 International Conference on*.Vol. 4.IEEE, 2011.

[10]. "LM35 And Arduino - Temperature Display Using LCD". *Electronic Circuits and Diagram-Electronics Projects and Design*.N.p., 2017. Web. 21 Apr. 2017.

[11]. "Arduino - LiquidCrystal", *Arduino.cc*, 2017.

[12]. "Keypad Interfacing with Arduino Uno: Circuit Diagram & Code Explanation", *Circuitdigest.com*, 2017.

[13]. Shivashankar, "Design and development of new apparatus in VANETs for safety and accident avoidance", Proceedings of IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), ISBN: 978-1-5090-0774-5, DOI: 10.1109/RTEICT.2016.7808122, pp. 1695 – 1698, 2016.

[14]. Shivashankar, "Development of agile frequency synthesizer", Proceedings of IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), ISBN: 978-1-5090-0774-5, DOI: 10.1109/RTEICT.2016.7808175, pp. 1943 – 1945, 2016.

[15]. Shivashankar and Pramod, "Random node deployment and route establishment in receiver based routing protocol for WSNs", Proceedings of IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), ISBN: 978-1-5090-0774-5, DOI: 10.1109/RTEICT.2016.7807786. pp. 74 – 78, 2016.

[16]. Shivashankar and G. R Poornima, "An efficient mobile sink path selection approach for WSN's", Proceedings of IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), ISBN: 978-1-5090-0774-5, DOI: 10.1109/RTEICT.2016.7807802, pp.151-155, 2016.

[17]. Shivashankar, P Rajendra Prasad, S Santosh Kumar and K N Sunil Kumar, "An efficient routing algorithm based on ant colony optimisation for VANETs", Proceedings of IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), ISBN: 978-1-5090-0774-5, 10.1109/RTEICT.2016.7807858, pp. 436 – 440, 2016.

[18]. Shivashankar, Ravigatti, P Rajendra Prasad, S Santosh Kumar and K N Sunil Kumar "Improvement of speed in data collection rate in tree based wireless sensor network", Proceedings of IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), ISBN: 978-1-5090-0774-5, 10.1109/RTEICT.2016.7807918, pp. 720 – 723, 2016.

[19]. Shivashankar and Dankan V Gowda, "Optimization of motorcycle pitch with non- linear control", Proceedings of IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), ISBN: 978-1-5090-0774-5, DOI: 10.1109/RTEICT.2016.7808114, pp.1656-1660, 2016.

[20]. Shivashankar, K N Sunil Kumar, Ravigatti, P Rajendra Prasad and S Santosh Kumar, "Opportunistic routing technique for minimized energy consumption for relay node selection in wireless sensor networks", Proceedings of IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), ISBN: 978-1-5090-0774-5, DOI: 10.1109/RTEICT.2016.7808208, pp. :2093 – 2097, 2016.