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IJIE

Journal homepage: http://penerbit.uthm.edu.my/ojs/index.php/ijie
ISSN : 2229-838X e-ISSN : 2600-7916

The International Journal of Integrated Engineering

Message Conveyor by Motion for Paralyze People Powered Using RF Energy Harvesting

Win Adiyansyah Indra[1*], Muhamad Shafiq Adam bin Mohd Shariff[1]

[1]Microwave Research Group (MRG),Centre for Telecommunication Research & Innovation (CeTRI),
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik (FTKEE),
Universiti Teknikal Malaysia Melaka (UTeM), Hang Tuah Jaya, Durian Tunggal, Melaka, 76100, MALAYSIA

*Corresponding Author

DOI: https://doi.org/10.30880/ijie.2020.12.08.022
Received 13 February 2020; Accepted 18 May 2020; Available online 31 August 2020

Abstract: This paper developed message conveyor for paralyze people, it designed to help them communicate because some of the paralyze people cannot or hardly talk. This project is introducing the latest and current technology update in the aera, RF energy harvesting. RF energy harvesting is an option to powering the circuit by converting RF energy to DC power. RF energy is generated from the ambient environment transmitted by millions of radio transmitters and telecommunications media around the globe, such as wireless internet, mobile phones, base station, broadcasting station, Wi-Fi and a Radio Frequency transmitter. RF energy is a long-lasting replacement of power if the Radio Frequency signal is present in the surrounding area. Arduino Mega is used in this project as it is easier to program the coding and a low power sensor. The project serves the needs of the community as it can assist paralyses people to communicate and can enhance the reduction of electricity bills as the RF signal controls the motion sensor.

Keywords: Message conveyor, RF energy harvesting, Arduino

1. Introduction

The part includes the background of the study, the statement of the problem, the objectives of the project to be accomplished and the scope of the work to be conducted, and then the contribution of the project will be followed. It is necessary to mount this device on the wrist of the user. The user must tilt the device to convey a message in a angle. On the other hand, an RF receiver receives the data and then decodes it to the microcontroller to process and respond to the input [1]. The objectives of this project: To develop a system that helps paralyze to convey a message. To implement energy harvesting from Radio Frequency to power the circuit. To analyse the Radio Frequency Energy Harvesting performance implements on the circuit. The scope of this project is to introduce the technology that can be used in hospitals or households to help paralyze people when they are hungry, thirsty, etc. The harvesting of RF energy is an RF to DC converter powering the circuit.

A block diagram is a diagram showing a system in which each component shown by blocks connected to the project process lines. Details on project components and flow given in the block diagrams. In essence. Three-block diagrams, for example, the total project, are attached, and the breakdown part is the RF Energy and Gesture Sensor block diagrams. The block diagram in Figure 1 shows the overall process in this project.it is beginning to capture all the radio frequency by using the RF to DC circuit antenna. Once the RF generates the voltage and power to the DC circuit, it also enhances the gesture sensor. It is using Arduino Uno or microcontroller to operate the gesture sensor. After that,

*Corresponding author: adiyansyah@utem.edu.my

it will display the sensor of gesture on the LCD. Figure 2 is a block diagram illustrating special for RF Energy Harvesting. The RF transmitter harvests radio frequency and will be captured by the antenna. RF to the DC circuit using several components indicated in the diagram below [2]. When the power and tension are extracted, and the gesture sensor is applied.

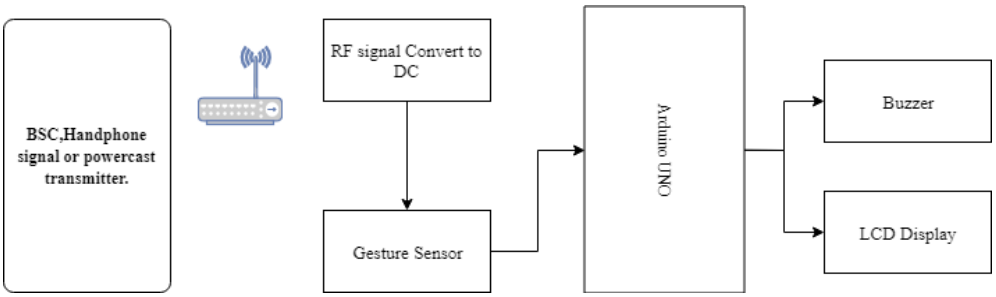


Fig. 1 - Overall process block diagram

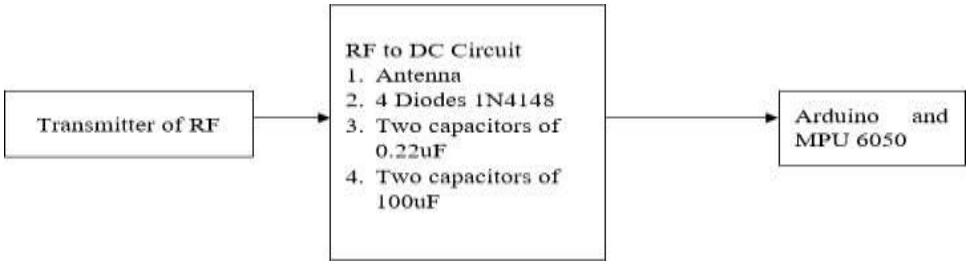


Fig. 2 - RF energy harvesting block diagram

2. Methodology

Radio Frequency (RF) Energy Harvesting in Software Application

A block diagram is a diagram showing a system in which each component shown by blocks connected to the project process lines. Details on project components and flow given in the block diagrams. In essence. Three- block diagrams, for example, the total project, are attached, and the breakdown part is the RF Energy and Gesture Sensor block diagrams. The schematic design of Radio Frequency Energy Harvesting developed using Multisim Software is shown in Figure 3. Multisim software is not accurate and proper to develop Radio Frequency Energy Harvesting software because it cannot generate voltage and current based on increasing and decreasing distance from the received Radio Frequency transmitter [3]. Nevertheless, multisim will demonstrate Radio Frequency Energy Harvesting's basic concept. Various electronic components, function generator, and multimeter were used to model the circuit connections. To get the value of voltage and current of the received signal, multimeter was connected in the circuit. To set the frequency value at 915MHz, a function generator that represents an antenna was attached. Table 1 shows the transmitted frequency vs. voltage and current value. For the hardware, 915MHz of radio frequency signal was transmitted by the Powercast transmitter. Focusing on the 915MHz frequency implemented in the function generator based on the software layout in Figure 3, the value of the voltage is 3. 071V, and the current is 267. 093mA. The voltage and current produced in the developed software were almost the same as the design of the hardware, so it was sufficient to implement the software design [4].

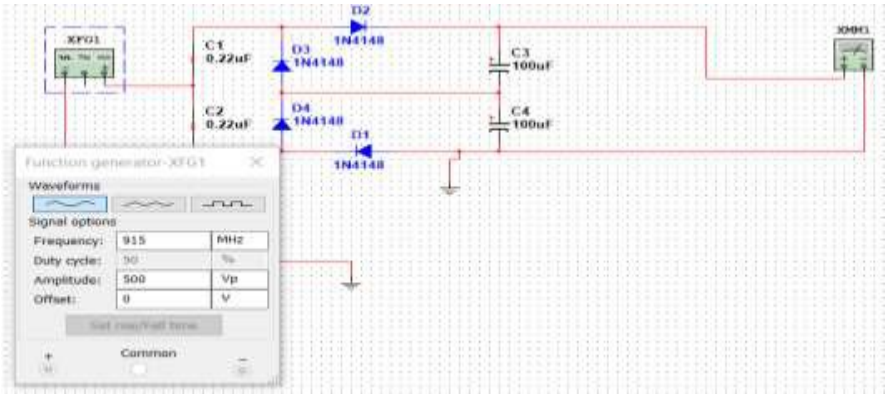
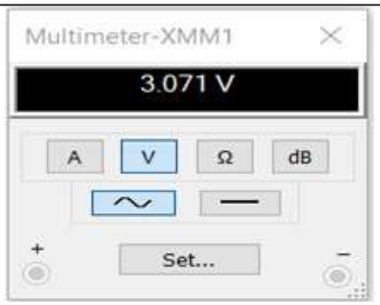


Fig. 3 - Setup for the simulation of the rectifier circuit

On Table 1, the result of simulation of radiofrequency energy harvesting could be seen that it gave a voltage at 3.071V and 267.093 mA of current on this simulation that could be seen on Multimeter of multisim.

Table 1 Value of Voltage and Current from Simulation Of Multisim

Voltage	Current
	

Radio Frequency (RF) Energy Harvesting in Hardware Application

A block diagram is a diagram showing a system in which each component shown by blocks connected to the project process lines. Details on project components and flow given in the block diagrams. In essence. Three-blocks diagrams, for example, the total project, are attached, and the breakdown part is the RF Energy and Gesture Sensor block diagrams. Figure 3 demonstrated that an antenna was used to capture the Radio Frequency energy harvesting circuit. Using a female connector, the antenna was attached. Radio Frequency powered the Radio Frequency energy harvesting circuit. Figure 4 is RF Transmitter, the power of the transmitter is 2. 5W and transmits the signal strength of 915MHz [5]. The device is currently tested to work only in the Radio Frequency (RF) near field.

Fig. 4 - Powercast powerspot (Radio Frequency Transmitter)

3. Result

The Radio Frequency energy harvesting is successfully developed in hardware design and software design. Both designs were able to measure the current and voltages. Several criteria further analyzed on the performance of Radio Frequency energy signal based on the hardware design, such as :

- The Amount of Received Signal by Using Different Types of Antenna
- Duration of Discharging and Charging of The Battery
- RF received signal and signal strength performance in light-of-sight (LOS) and Non- Line-of-Sight (NLOS)

The Received Signal of Antenna in Radio Frequency Energy Harvesting Circuit.

Analysis of the received signal of Omni-Directional in Radio Frequency energy harvesting circuit was observed and recorded as in the below:
The distance affects the received signal by Radio Frequency Energy Harvesting. Based on and figure 5 below shows that the more distance between radio frequency, the low the voltage of the received signal.

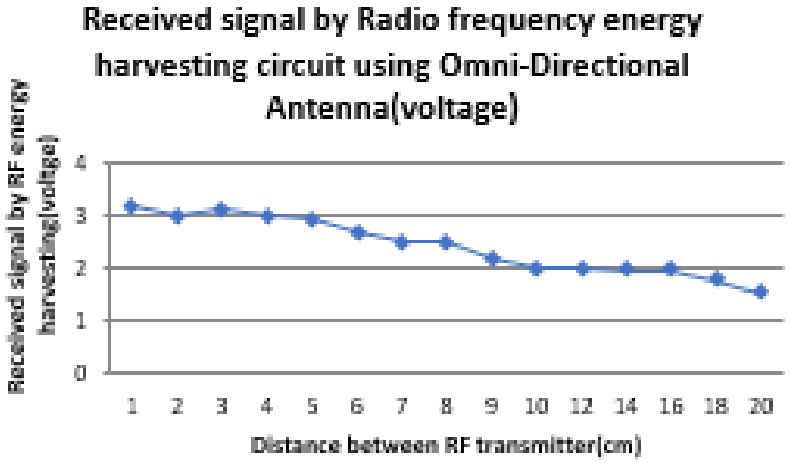


Fig. 5- Distance between the Radio Frequency Energy Circuit with Radio Frequency Transmitter (cm) vs Received signal by Radio frequency energy harvesting circuit using Omni-Directional Antenna (voltage)

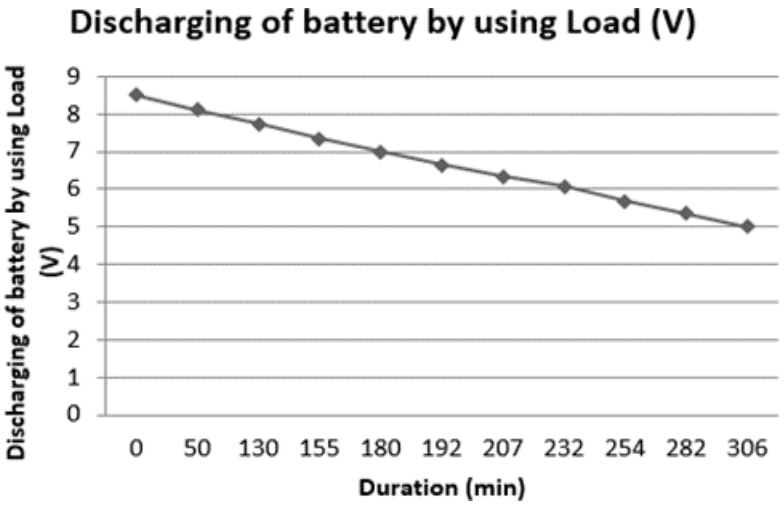


Fig. 6 - Duration of discharging battery by using load

Through processing the radio signal from the radio frequency transmitter, the charging battery was applied. The battery needs to discharge first before the charging test took place. This test and analysis took place when the charging board range from the radio frequency transmitter was about 1 cm close to the received signal. The relationship as indicated, when the charging board is closest to the received signal, the charging board's LED will be brighter, the received signal voltage will be larger, making the battery charging the fastest in a short time, respectively. The battery was used in the test run of the project with a size of 850mAH and 9V [6]. The load used in this project was an LED bulb to see how long it took to complete the current capacity of the battery. In figure 6, As the duration increased as time goes on, the discharge taken by the battery by using the load is decreasing with the fixed current. The test run was to stop when the battery was not producing any current to light the LED bulb. As figure 7 shown, analysis of battery charging time in using RF power and when the voltage battery increased proportionally to the time increased, respectively. Within 655 minutes, the battery was fully charged.

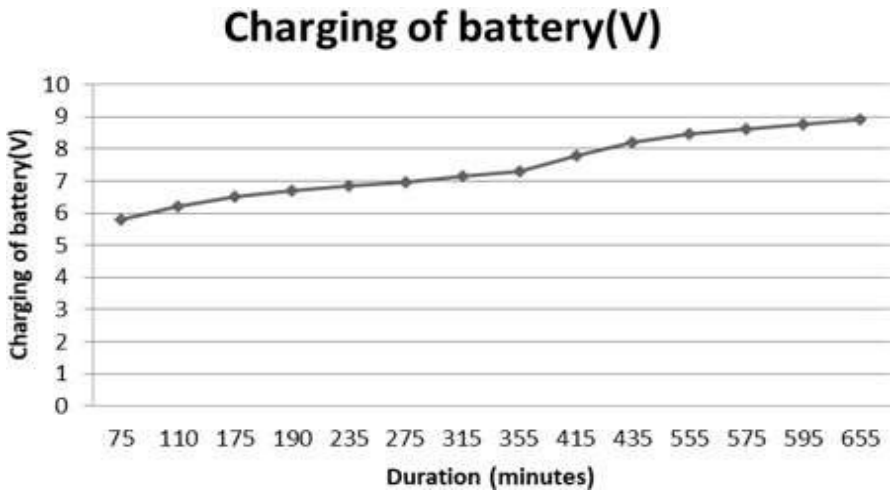


Fig. 7 - Duration of charging battery

4. Discussion

RF Received Signal and Signal Strength Performance in Light-of-Sight (LOS) and Non-Line-of-Sight (NLOS).

This research was carried out by applying the Line of Sight and Non-Line-of- Sight theory. Line-of-Sight means that the RF transmitter array hits directly without any barriers to the RF receiver signal loop. NLOS, which implies that barriers exist between the RF transmitter and the signal circuit transmitted by the RF [7]. Books used between the transmitter and the RF provided a signal circuit in this experiment to reflect the obstacles and block the signal. The voltage for directional and Omni- directional antenna for LOS was higher than NLOS as a result of the above table. This is because the signal intensity is transmitted at maximum power for the LOS case. The receiving signal is faced with difficulties in passing through which can relate in daily communication compared to NLOS. Examples, if the path between the base station and the subscriber mobile station has difficulty penetrating the RF signal, can be identified as NLOS in urban areas with several tall buildings. Because of this effect, the signal is attenuated, absorbed, and at different times the signal arrives at different amplitudes.

Schematic Implementation on MPU6050 for Message Conveyor for Paralyze People.

Figure 8 illustrates the message conveyor schematic circuit for people with disabilities. This schematic was designed using software from Fritzing. Figure-based connections consist of a breadboard with an Arduino attached that serves as a process brain. Next, the MPU6050 detector was used to monitor the gyroscope and accelerometer. The LCD acts as a system output. Once the MPU6050 move has been detected, the LCD will show up [8].

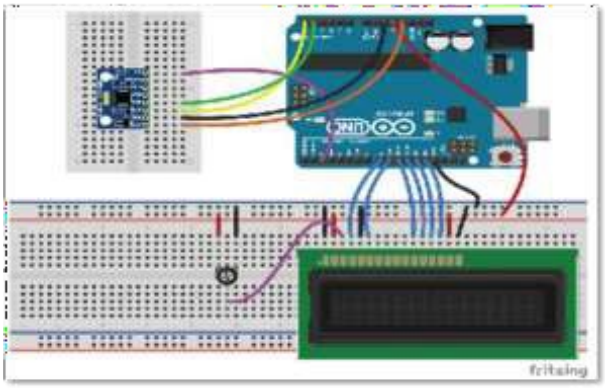


Fig. 8 - Message conveyor breadboard circuit for people with disabilities

Hardware Implementation on MPU6050 for Message Conveyor for Paralyze People

Figure 9 demonstrates the hardware connection of the Arduino stack to the LCD and MPU6050. The Arduino and MPU6050 are supplied with the power supply from the battery, which stores RF energy. The battery used is 9V with 850mAH, which is enough to power the circuit. The LCD is designed to display a message from MPU6050. MPU 6050 is used to detect the degree and then to convert it to a message. In this project, Arduino has a brain, a library of MPU 6050 and an LCD. All the coding is on the Arduino, the MPU set to deliver the message and display to the LCD.

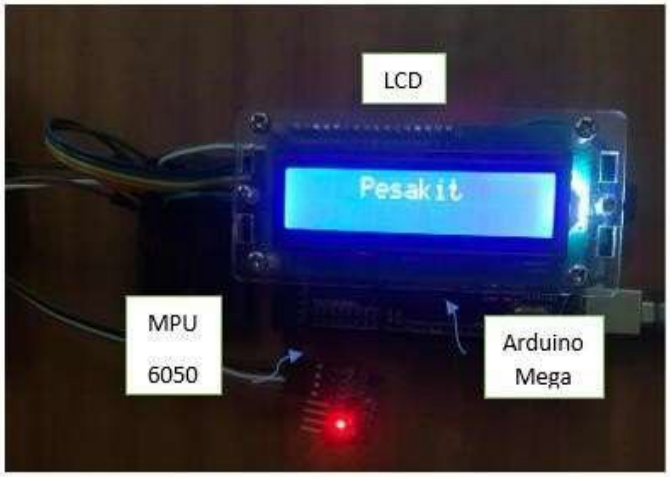


Fig. 9 - Message conveyor hardware circuit for people with disabilities

The result of this project proves that the Radio Frequency signal can generate voltage and current using the Radio Frequency Received signal that converts the Radio Frequency to the Direct Current circuit. The voltage obtained could charge the battery. The simulation and hardware design to demonstrate RF Energy Harvesting concept was successful using Multisim Software while the breadboard and solder circuit was built for hardware design. For hardware and software, the voltage and current calculated were roughly 0.1 0. 6V and 0.1 0.9mA. The volume of RF provided a high signal in LOS as opposed to NLOS. There was no barrier between the transmitter and the RF energy harvesting circuit. When the charging board and the radio frequency transmitter were about 1 cm to 2 cm away, the best distance to charge the battery. It also tracked and measured the charging and discharging of the battery. Through applying the discharge, the time taken was about 306 minutes, while the battery took about 655 minutes to charge the RF signal for charging the circuit. RF Energy Harvesting can power any low-powered appliances [9]. Thus, the MPU6050 was selected for the RF energy to power. First, the

implementation of the MPU6050 project was successful in the development of the hardware. The MPU6050 will be located near the knuckle, which is at part of the finger at the joint where the bone is close to the surface, in particular where the finger joins the hand. Once the MPU6050 detect movement, automatically the LCD will display the message. The entire sensor operation was powered by RF energy. Due to the low power consumption of the MPU6050 sensor and Arduino, the battery was implemented which was charged by Radio Frequency Energy Harvesting. From the results and analysis obtained, the voltage and current produced by the RF energy harvesting extract from the Radio Frequency signal that power the low power sensor MPU6050 and Arduino. The objectives accomplished as the development success of the project.

The project's limitation receives low voltage and current as of the RF Energy Harvesting. First, the conditions of the environment or space are critical and need to be considered to capture the Radio Frequency signal. Not every location has received a higher radio frequency signal and needs to be replaced with Radio Frequ ency Transmitter. First, the battery was only built to be changed manually. So, once the voltage of the battery is weak, it needs to connect the battery to the charging board for manual charging in the radio frequency signal. Next, it takes quite a long time to charge the battery.

5. Conclusions

The project has three objectives to accomplish to be successful. To implement the Energy Harvesting Radio Frequency to power the circuit. The Radio Frequency is stored in the battery through the RF to DC circuit, and the battery is charging. The battery will then be attached to the Arduino and MPU 6050, and it will operate as needed. Third, energy harvesting performance implements on the circuit are recorded for analysis of Radio Frequency and data observation and measurement in the previous chapter. Radio Frequency Energy Harvesting receives radio frequency signal and produces low voltage and current, charging the battery and Arduino starting it up. This project also accomplished this project's methodology, which is the Gantt chart, the flow chart and the block diagram. Lastly, the previous Radio Frequency Energy Harvesting and MPU6050 research that was further will apply to this project. As the objectives have been accomplished, the achievement of this project is a success.

Acknowledgement

The authors would like to thank Universiti Teknikal Malaysia Melaka (UTeM) for sponsoring this work under the Grant Sanjungan Insentif Penerbitan Jurnal 2019 No. JURNAL/2019/FTKEE/Q00047.

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