Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 09, pp.38715-38719, September, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

DEVELOPMENT OF TELEMETRY SYSTEM FOR ELECTRIC POWERED VEHICLE

[1]Eray ÖNLER, [2]Soner ÇELEN, [2]Aytaç MORALAR and *[1]İlker H. ÇELEN

[1]Department of Biosystem Engineering, Faculty of Agriculture, Namik Kemal University
[2]Deparment of Mechanical Engineering, Faculty of Engineering, Namik Kemal University

ARTICLE INFO

Article History:
Received 22nd June, 2016
Received in revised form
25th July, 2016
Accepted 17th August, 2016
Published online 30th September, 2016

Key words:
Electric vehicle,
Communication,
Telemetry system,
Agriculture

ABSTRACT

Wireless electronic telemetry system is designed for prototype electric powered agricultural vehicle. Telemetry system is crucial for electric vehicles to monitor its data, remotely. It is important to measure electrical parameters in real time for safe operation. Designed telemetry system consists of hardware and software which can broadcast information by using wireless connection over serial communication protocol. Wireless connection range is up to 3 km which is sufficient for using at orchards. The designed data acquisition and telemetry system is based on RF modem. Graphical user interface is also written by using C# and Visual Basic programming languages for monitoring device features easily from groun station. Vehicle speed, voltage levels and temperature of battery packs, drawing current, total power usage and remained battery power can be monitored by this system.

Citation: Eray ÖNLER, Soner ÇELEN, Aytaç MORALAR and İlker H. ÇELEN, 2016. "Development of telemetry system for electric powered vehicle", *International Journal of Current Research*, 8, (09), 38715-38719.

INTRODUCTION

Telemetry is an automated communications process by which measurements and other data are collected at remote or inaccessible points and transmitted to receiver for monitoring (Zhang *et al*., 2009). Most activities in agriculture is need to monitor continously. Quality of the yields and health of the crops is depends on how can you reach to available data. It has become a major challange to control the growth of energy consumption with the acceleration of agricultural mechanization in Turkey, which causing the increasing dependency on energy sources such as fossil fuels. Fossil fuels are environmentaly polluted and expensive (Hammad 1996). Clean and renewable energy solutions are started to use in transporting industry (Carrol, 2003). In agriculture during last years, farmers have passed from the use of big tractors to the use of small and efficient vehicles. Electrical vehicles are used in agriculture for different purposes like farms, nurseries, greenhouses and vineyards. They are giving advantage to farmers by their compact dimensions and efficient power usage (Fantuzzi *et al*, 2006).

Corresponding author: [1]İlker H. ÇELEN
Department of Biosystem Engineering, Faculty of Agriculture, Namik Kemal University

Electric vehicles are using electric batteries as an energy source. For safe operation and effective usage of the batteries it is important to monitor the voltage, current, vehicle speed and the battery capacity (Lobardi *et al*, 2006; Touti *et al*, 2009; Zhihong *et al*, 2009).

Materıal and methods

This system is designed for using in agricultural vehicles. It is communicating via serial communication protocol. Purpose of the system is making data transfer between the remote station and vehicle. Measured data by the data-acquisition system are sending to remote station in real time. Graphical user interface at remote station is making mathematical calculations on data for determining the current, voltage, cruise speed, temperature of the battery bank, remained battery power, consumed energy. These results are saving into a database (Figure 1). After transfering the data which is measured by the electrical system on the vehicle, this data is transferred to the remote station for making safety and drive strategy calculations. Motor power, instantaneous current draw, battery voltage, power usage per unit, current draw per unit, remaining battery power, max. and min. battery temperature, max. and mean cruise speed can transferred to the remote station (Figure 2).

Circuit Design

Schematic draws, creating PCB (printed circuit board) and analysis of this circuit is done by using Proteus 8.1 circuit design software. Serial communication is accomplished by MAX232 integrated circuit and microprocessor on the main board. RF modem transmitter and an antenna are installed in the vehicle for transmitting the serial data. Schematic draw of the circuit can be seen at the Figure 3.

Communication protocols

Serial port protocols were used in the telemetry system. Serial communication is one the methods for electronic communication systems. It is also known as UART communication (Stone, 1999). UART is chip type which is using at serial port connections. Serial port communcation is done by 8 bit. For example letter "a" can represent as 01000001 in 8 bit system.

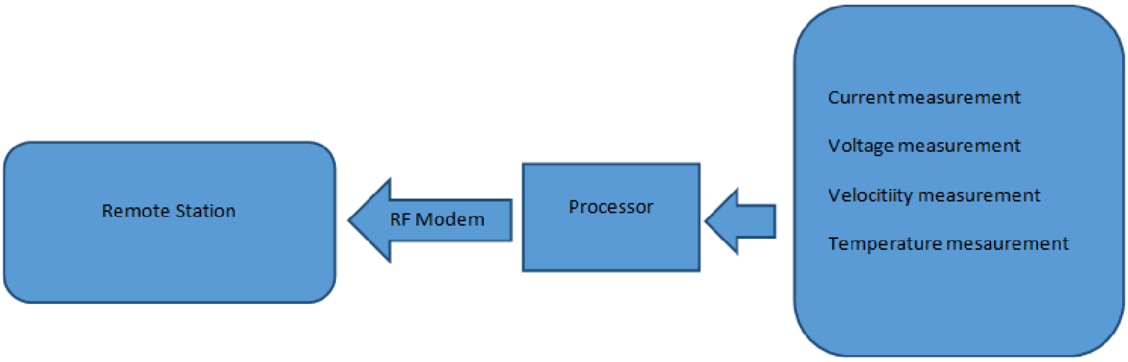

Figure 1. Telemetry system diagram

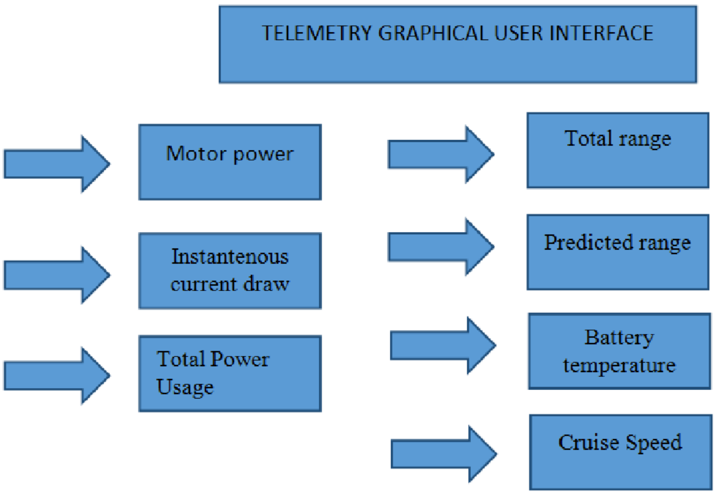

Figure 2. Telemetry system graphical user interface

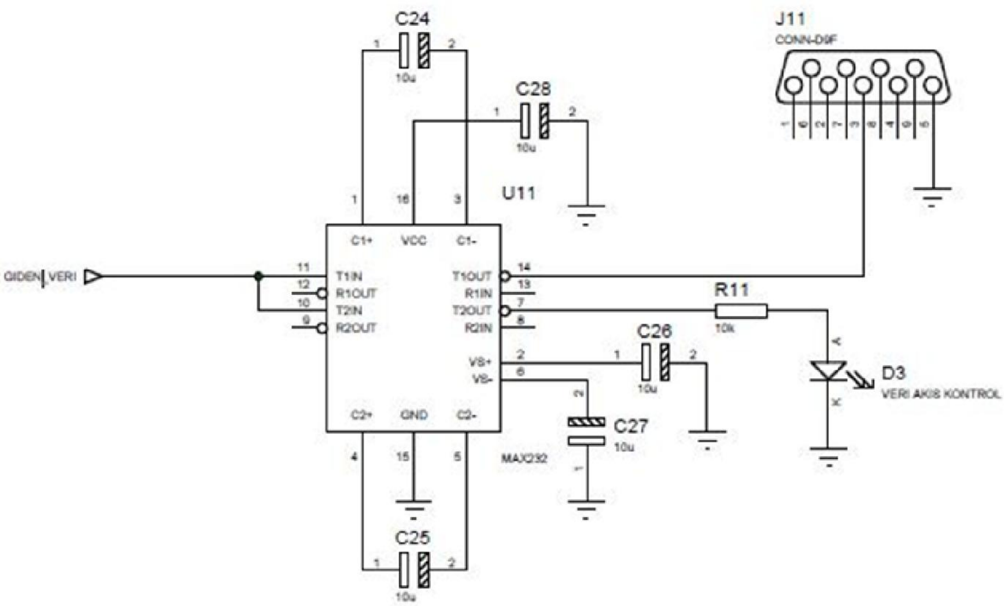

Figure 3. Serial communication circuit

Baud Rate: Amount of bit that serial port can write in a second. For example we can calculate the speed of writing 12 character with a 9600 bps (bit per second) serial port : 12 x 8 = 96 bit, 96/9600 = 0.01 second.

Stop Bits: In serial communications one stopping bit is added at the end of every byte of information. This tells the recevier device that the byte is ended and become synchronized again. Parity: Parity bits are used for detection the faults.

Production

Telemetry system is consist of software and hardware parts. Hardware part is explained at the circuit design section. Software part is programmed at the Microsoft Visual Studio 2013 by using C# and Visual Basic programming languages. Algorithm of the telemetry system is programmed with Multi-Threading method. Purpose of the using this method is improving the system performance and avoid possible program crashes. Speed of the program execution increases very much, especially at the multicore processor pc's. At the multi-threaded programs, when an exception is happened just the related thread is stopped instead of all the program (Figure 4).

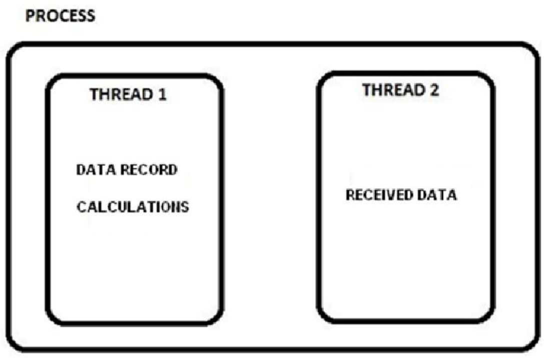

Figure 4. Multi-thread program

Threads are the independent parts of the whole program. Algorithm of the telemetry software is showned below (Figure 5)

RESULTS

Graphical user interface is designed as follow. This interface is designed for easy to use by the end users (Figure 6).

```
Private Sub Hesap()

    On Error Resume Next
    MotorGucu = y_batarya * y_motor
    Top_Panel_Akim = y_mppt1 + y_mppt2 + y_mppt3
    Bataryadan_Cekilen_NetAkim = y_motor - Top_Panel_Akim
    Harcanan_AmperSaat = Harcanan_AmperSaat + ((Bataryadan_Cekilen_NetAkim + Eski_Bataryadan_Cekilen_NetAkim) / 2) / AyrikZaman
    Harcanan_WattSaat = Harcanan_WattSaat + ((Bataryadan_Cekilen_NetAkim + Eski_Bataryadan_Cekilen_NetAkim) / 2) * y_batarya / AyrikZaman
    Motor_AmperSaat = Motor_AmperSaat + ((y_motor + Eski_Motor_Akim) / 2) / AyrikZaman
    Motor_WattSaat = Motor_WattSaat + ((Eski_Motor_Gucu + MotorGucu) / 2) / AyrikZaman
    Panel_AmperSaat = Panel_AmperSaat + ((Eski_Panel_Akim + Top_Panel_Akim) / 2) / AyrikZaman
    Panel_WattSaat = Panel_WattSaat + ((Eski_Panel_Gucu + Top_Panel_Gucu) / 2) / AyrikZaman
    Tur_Basi_WattSaat = Tur_Basi_WattSaat + ((Bataryadan_Cekilen_NetAkim + Eski_Bataryadan_Cekilen_NetAkim) / 2) * y_batarya / AyrikZaman
    Kalan_WattSaat = 1000 - Harcanan_WattSaat
    Harcanan_TurBasi_AmperSaat = Harcanan_TurBasi_AmperSaat + ((Bataryadan_Cekilen_NetAkim + Eski_Bataryadan_Cekilen_NetAkim) / 2) / AyrikZaman
    Ortalama_Kalan_TurBasi_WattSaaat = Kalan_WattSaat / (20 - tur)
    Pil_Verileri_A = y_motor - Panel_AmperSaat
    Menzil = Menzil + y_hiz / AyrikZaman
    Batarya_Watt = y_batarya * Pil_Verileri_A
    Max_Sicaklik_Bul()
    Max_Hiz_Bul()
    Ort_Hiz_Bul()
End Sub
```

Figure 5. Telemetry software

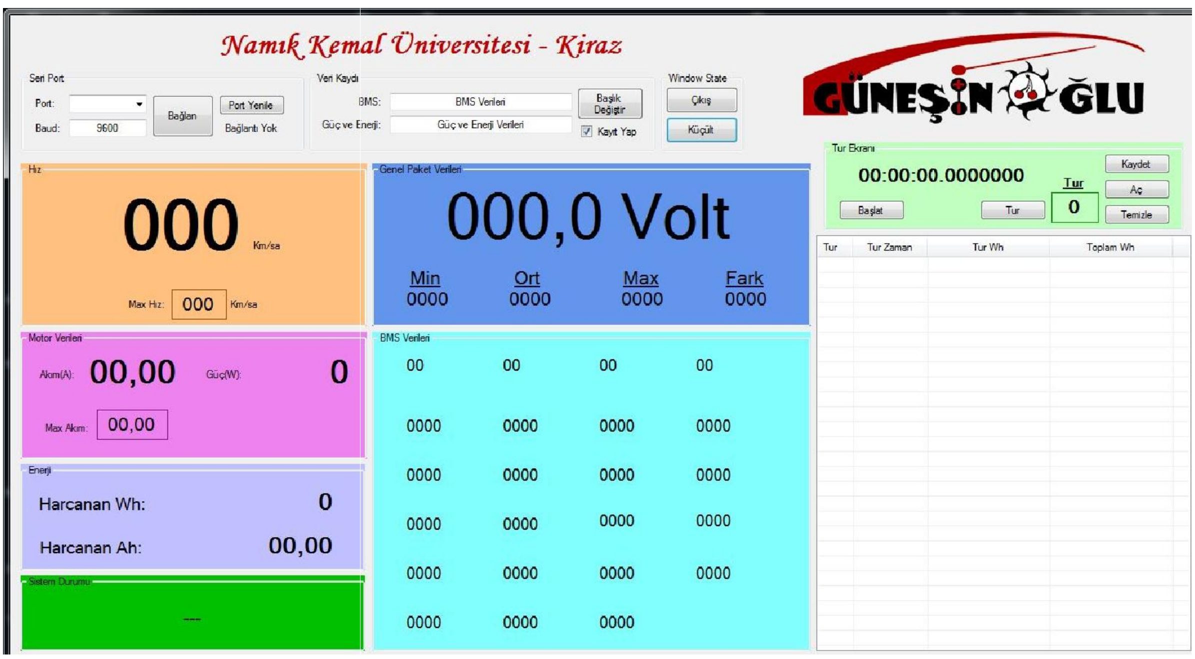

Figure 6. Graphical user interface

	A	B	C	D	E	F	G	H	I	J
1	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
2	0	0	0	0	0	0	0	0	0	3615
3	3615	3616	3616	3618	3616	3616	3616	3616	3618	3615
4	3615	3616	3616	3618	3616	3616	3616	3616	3618	3613
5	3615	3616	3616	3618	3616	3616	3616	3616	3616	3613
6	3615	3616	3616	3618	3616	3616	3616	3616	3618	3615
7	3615	3616	3616	3618	3616	3616	3616	3616	3616	3613
8	3615	3616	3616	3618	3616	3616	3616	3616	3618	3613
9	3615	3616	3616	3618	3616	3616	3616	3616	3616	3613
10	3615	3616	3616	3618	3616	3616	3616	3616	3618	3613
11	3615	3616	3616	3618	3616	3616	3616	3616	3618	3613
12	3615	3616	3616	3618	3616	3616	3616	3616	3618	3613
13	3615	3616	3616	3618	3616	3616	3616	3616	3618	3615

	A	B	C	D	E	F
1	Hiz	Gerilim	Akim	Durum		Saat
2	0	0	0	0		14:18:05
3	0	0	0	0		14:18:06
4	0	0	0	0		14:18:07
5	0	0	0	0		14:18:08
6	0	0	0	0		14:18:09
7	0	0	0	0		14:18:09
8	0	0	0	0		14:18:10
9	0	0	0	0		14:18:11
10	19	0	0	0		14:18:12
11	6	0	0	0		14:18:13
12	0	0	0	0		14:18:13
13	6	0	0	0		14:18:14
14	0	0	0	0		14:18:15
15	25	0	0	0		14:18:16
16	0	0	0	0		14:19:21
17	0	0	0	0		14:19:21
18	0	0	0	0		14:19:22
19	0	0	0	0		14:19:23
20	13	0	0	0		14:19:24
21	13	0	0	0		14:19:24
22	19	0	0	0		14:19:25
23	50	0	0	0		14:19:26
24	32	0	0	0		14:19:27

Figure 7. System Records telometri

User can follow the most important parameters of the electric vehicle. It is also possible to record this informations into excel files. Some measurements which are recorded by the system to an excel file is showed below. As shown in the Figure 7 it is possible to inspect voltage of all battery packs, speed of the vehicle, current draw, battery usage.

Conclusion

In agriculture during last years, farmers have passed from the use of big tractors to the use of small and efficient vehicles. Electrical vehicles are used in agriculture for different purposes like farms, nurseries, greenhouses and vineyards. They are giving advantage to farmers by their compact dimensions and efficient power usage. Electric vehicles are using electric batteries as an energy source. For safe operation and effective usage of the batteries it is important to monitor the voltage, current, vehicle speed and the battery capacity. Wireless electronic telemetry system is designed for prototype electric powered agricultural vehicle. Telemetry system is crucial for electric vehicles to monitor its data, remotely. It is important to measure electrical parameters in real time for safe operation. Designed telemetry system consists of hardware and software which can broadcast information by using wireless connection over serial communication protocol. Wireless connection range is up to 3 km which is sufficient for using at orchards.

Acknowledgements

This study has been conducted within the scope of Namik Kemal University "NKUBAP.00.24.KR.14.01". Thanks for their contributions.

REFERENCES

Carrol, D.R. 2003. The Winning Solar Car, SAE International

Fantuzzi, C., Marzani, S., Secchi, C., Ruggeri, M., 2006. A Distributed Embedded Control System for Agricultural Machines. In: IEEE International Conference on Industrial Informatics, Singapore.

Hammad, M., Khatib,T., 1996. Energy Parameters of a Solar Car for Jordan, Energy Convers. Mgmt Vol.37 No 12. Pp. 1695-1702.

Lobardi, P., Giaconia, C.G., Di Dio, V., 2006. An Embedded Diagnostic System for Wheelchairs Brushless Drives Monitoring. In: International Symposium on Power Electronics, Electrical Drives, Automation and Motion, Taormina.

Stone, M.L., 1999. ISO 11783 – An Electronic Communications Protocol for Agricultural Equipment. ASEA Distinguished Lecture Series.

Touati, Y., Ali-Cherif, A., Achili, B., 2009. Smart Wheelchair Design and Monitoring via Wired and Wireless Networks. In: IEEE Symposium on Industrial Electronics and Applications, Kuala Lumpur.

Zhang, Y., Salman, M., Subramania, H.S., Edwards, R., Correia, J., Gantt, G.W., Rychlinski, M., Stanford, J., 2009. Remote Vehicle State of Health Monitoring and Its Application to Vehicle No-Start Prediction. In: IEEE Autotestcon, Anaheim.

Zhihong, T., Jinsheng, Y., Jianguo, Z., 2009. Location Based Services Applied to an Electrical Wheelchair Based on the GPS and GSM Networks. In: International Workshop on Intelligent Systems and Applications, Wuhan.