REVISTA ELECTRO, Vol. 44 pp. 40-45, Oct 2022, Chihuahua, Chih. México
http:// electro.itchihuahua.edu.mx/revista
ISSN 1405-2172

AUDIT BY DATALOGGING

[1]Arana-de-las-Casas Nancy Ivette, Pérez-Piñón Mauricio, Sáenz-Zamarrón David, García-Grajeda Enrique, Alatorre-Ávila José Francisco
[1]*Tecnológico Nacional de México / Instituto Tecnológico de Cd. Cuauhtémoc*
Maestría en Ingeniería. Ingeniería Mecatrónica
Av. Tecnológico No. 137, Cuauhtémoc, Chih. México. C.P. 31500
52 (625) 581 1707
[1]narana@itcdcuauhtemoc.edu.mx

RESUMEN

Datalogger es un dispositivo electrónico basado en microcontroladores que registra datos en el tiempo y ubicación proporcionados por instrumentos. Son pequeños, con pilas, portátiles y equipados con un microprocesador, memoria interna para almacenamiento de datos.

En este proyecto se muestra la creación de una copia de seguridad en una tarjeta microSD utilizando 2 módulos de SparkFun: uno es el Level Shifting microSD Breakout, otro es el SparkFun Level Shifting microSD Breakout. La copia de seguridad registra varios parámetros de identificación, climatológicos y de ubicación generados por los módulos: RFID, Weather Kit de Sparkfun y GPS GP-635t.

Palabras Clave: Datalogger, microSD, RFID, Weather Kit, GPS.

ABSTRACT

Datalogger is an electronic device based on microcontrollers that records data in time and location provided by instruments. They are small, battery powered, portable, and equipped with a microprocessor, internal memory for data storage.

This project shows how to create a backup to a microSD card using 2 SparkFun modules: one is the Level Shifting microSD Breakout, another is the SparkFun Level Shifting microSD Breakout. The backup records various identification, weather, and positioning parameters generated by the Sparkfun modules: RFID, Weather Kit, and GP-635t GPS.

Keywords: Datalogger, microSD, RFID, Weather Kit, GPS.

1. INTRODUCTION

Audits are considered as the examination, control, and follow-up of a situation in which an organization finds itself. In this way you can know and detect which processes work and which do not do it in the right way, also provides information to change the process, or in the case that if they work, know how they can be improved and reinforce the important points.

Dataloggers are information-recording devices that monitor data in real time. They have the capacity to record a considerable amount of data over a period, they are important to be able to elaborate detailed records in the long term.

An embedded system is the datalogger, which can be used, working in conjunction with other embedded systems to improve inventory control and make a backup of a database where the use of some property of interest is recorded.

In every process there are always incidents, so there is a need to record the information that is generated to have a control when certain unexpected events occur, in such a way as to identify the causes of such incidents or system failures.

In the case of the information record there are usually problems in the loss and/or bad order of these records, in such a way that it is also necessary to save backups of these in case of losing this information in the main database.

Continuously it has been sought to improve the systems in such a way that they are safer and easier to use, in the case of information management it is usually complicated or unproductive for a user to attend and analyze records continuously for a long period of time.

Some examples of information problems in different organizations are educational centers, health centers or museums, among others. In some places it is very important to have good air quality, in others, the conservation of books, or paintings and sculptures. It can also be presented as a necessity, the recording of the weather (temperature, humidity, wind). Recording the data obtained manually by the sensors is an unproductive activity. For example, in warehouses, there is a waste of time when manually typing the data of users who require material or equipment.

Some labor was found related to the recording of information.

[1] features an open-source, ultra-low power data logger for off-grid photovoltaic (PV) systems. The deep sleep mode of the ESP32-S2 microcontroller is used in conjunction with voltage, current and light sensors to record the data of the photovoltaic power system on an external micro-SD card. A toggle switch is used to switch the operating modes of the data logger between deep sleep and *web* server modes. Real-time photovoltaic data can be monitored on a local *web* portal programmed into the microcontroller. The same web portal is also used to verify and download the historical data of a photovoltaic energy system. The power consumption of the designed system is 7.33 mWh during deep sleep mode and 425 mWh during *web* server mode.

[2] designs a system that can record the path traveled by a flying object on an MMC/SD card and then plotting it in the Google Earth *app* on a PC. The Global Positioning System (GPS) is used in transport, for tracking the position of the vehicle combined with an external memory card. These technologies can help track the entire journey of any moving vehicle or objects, transporting humans, animals, or objects. In this work, a vehicle positioning registration system is built using GPS and SD/MMC (Secure Digital/Multimedia Card).

The system consists of the next four modules. GPS data receiver, SD/MMC memory card interface, RS232 interface. Data processor (Microcontroller). The GPS data receiver module obtains the data from the GPS receiver and extracts the required data. The data storage module consists of an interface circuit between the microcontroller and the SD/MMC card. This module transmits the data to the SD/MMC card within two seconds. The data (at the end) is transferred to the PC via RS232 communication. Data capture is done using the HyperTerminal application on PC.

[3] use Serial Peripheral Interface (SPI) as the communication protocol that is applied as a communication interface between the microcontroller and the SD card. The SD card is formatted in FAT 16 format, the data on the SD card has the form of collecting data packets from a sensor that are periodically captured and saved in a *.csv* format file. Based on the format of the sensor data packet being created, the recorded data can be calculated in the time required for the SD card capacity to be fully filled with the sensor data. The results of the research show that the SPI method applied in this study has the properties of doing repeated tests on the MISO pin to the command sent by the microcontroller through the MOSI pin. The read/write data in the SD card data logger is 100% successful, because the SD card has been initialized in SPI mode via the *reset* and *init* SD Card command. This communication can be established using the 4 Mhz - 20 Mhz crystal. In SPI configuration tests, only the independent slave configuration can be used in SPI communication with 2 SD cards as a slave.

[4] develops a sock with a portable textile sensor for gait analysis. To provide long-term data portability and logging. Developed, a device with seven conductive polymer pressure sensors with a continuous operating time of 8 hours. The data was stored in a data logger placed in a backpack carried by the participant. To improve size, comfort, usability, and portability

[5] uses a data logger for a system with memory on SD card, in that system voltage, current, light intensity and temperature are monitored. Given this, the existence of energy saving opportunities is analyzed. By knowing how much electricity is used, the need for lighting and the temperature an effort is made to minimize energy use to be more efficient. Therefore, it is necessary to have a measuring instrument that can measure many parameters on a single occasion automatically and the results are stored in memory. The research performs a voltage, current, temperature and light monitoring tool along with a data logging system that can be applied to a room.

This article shows you a basic system for recording information from other embedded systems. The project focuses on creating a backup to a microSD card using SparkFun modules. Two different data loggers were used, one is the Level Shifting microSD Breakout, the other is the SparkFun Level Shifting MicroSD Breakout. The backup that is made works in such a way that it records several identifications, climatological, and location, parameters generated by the modules: RFID, Sparkfun Weather Kit and the GP-635t GPS. Specifically in RFID application, it records the unique identification of ID cards. On the other hand, in the Weather Kit application, it records wind speed/direction, temperature, relative humidity and global positioning.

2. DATALOGGER

[6] states that a data logger or datalogger is an electronic device that records data over time or in relation to the location of own or externally connected instruments. Almost all are based on microcontrollers. They are usually small, battery-powered, portable, and equipped with a microprocessor, internal memory for data storage, and sensors. Some data loggers communicate with a personal computer and use specific software to activate the data logger, view and analyze the collected data, while others have a local interface device (keyboard, screen, LCD) and can be used as a standalone device.

Data loggers range from general purpose loggers for a wide range of applications to very specific measuring devices for measuring in a particular environment or application. It is common for general purpose types to be programmable, however, many are static machines with a limited number of variable parameters. Electronic data loggers have replaced letter recorders in many applications.

One of the main benefits of using data loggers is the ability to automatically collect data 24 hours a day. Upon activation, data loggers are typically left unattended to measure and record information for the entire duration of the tracking period. This allows a global and accurate view of the environmental conditions being monitored, such as air temperature and relative humidity.

The cost of data loggers has been decreasing over the years as technology improves and costs are reduced. Single-channel data loggers can cost as little as 25 euros. Accurate and complex loggers can cost hundreds or thousands of dollars.

2.1 SparkFun Logomatic v2 – Serial Data Logger SD (FAT32)

Logomatic is a data logger that appears as a flash drive on any operating system. Logs are created in FAT32 format on the microSD media and can be downloaded via a USB connection by selecting the text files from the device. The card has a built-in RTC and 10 GPIO pins available [7]. See figure 1.

Fig. 1 SparkFun Logomatic v2.

2.2 Sparkfun Level Shifting MicroSD Breakout

This device supports the SPI interface found on any SD card, this small form factor was created for cell phone storage and is perfect for a data logging project [8].

3. CONECTIONS

The following describes the connections that are made between dataloggers and other embedded systems.

3.1 SparkFun Logomatic v2 turned on for the first time

The card is inserted into the Logomatic, a LiPo battery is plugged into the two-pin JST connector, and the switch is moved in the on position. The STAT0 and STAT1 LEDs flash and then turn off. See Figure 2.

Fig 2. LiPo battery connection.

3.2 Review of .TXT-type documents in SD memory

Two files were created on the card, LOGCON.TXT and LOG0.TXT. The first file is the configuration file and the second is the first registered file (empty). See Figure 3.

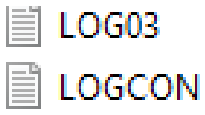

Fig 3. Files type .TXT.

3.3 Logomatic Settings

The configuration file opens in a text editor and the following default settings are observed. See Figure 4.

```
MODE = 0
ASCII = Y
Baud = 4
Frequency = 100
Trigger Character = $
Text Frame = 100
AD1.3 = N
AD0.3 = N
AD0.2 = N
AD0.1 = N
AD1.2 = N
AD0.4 = N
AD1.7 = N
AD1.6 = N
Safety On = Y
```

Fig 4. Default settings.

3.4 Hardware Connection with Arduino

Physically only the two grounds (gnd) the Arduino one with that of the logomatic are connected. The RX10 of the logomatic with the TX0 as shown in the figure. See Figure 5.

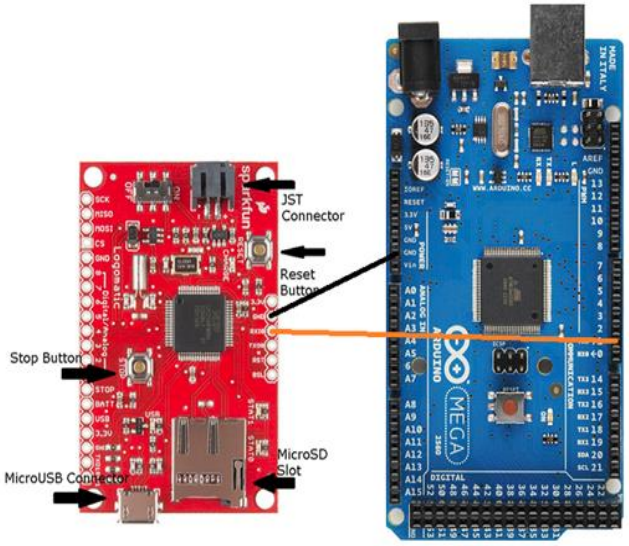

Fig 5. Hadware connection with Arduino.

It connects with the RFID module to make the data record of the credentials of the students of an educational institution, as shown in Figure 6.

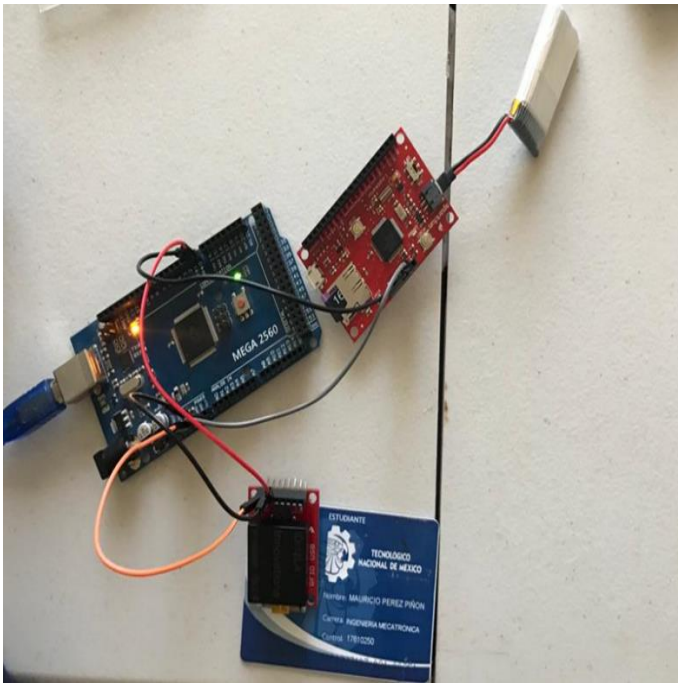

Fig 6. Connection with RFID module.

3.5 SparkFun Level Shifting microSD Breakout

As a second module, the SparkFun Level Shifting microSD Breakout was used. The connection can be seen in Figure 7.

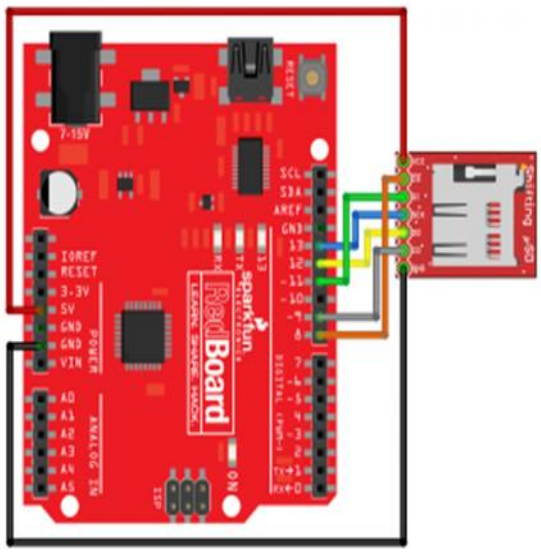

Fig 7. Datalogger connection.

3.6 Connection with Module XBEE

Two XBEEs are connected, one as a receiver and one as a transmitter, each on a different Arduino and an RFID module is also connected to it, as shown in Figure 8.

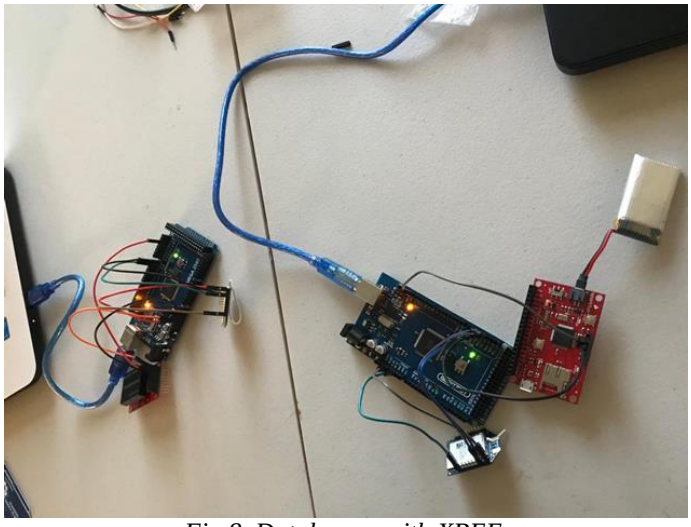

Fig 8. Datalogger with XBEE.

The connection of both XBEEs is in the same way, grounded the XBEE with the Arduino ground, powering 5V to the XBEE of the Arduino source and connecting TX of the XBEE with RX of the Arduino, as well as the RX of the XBEE with the TX of the Arduino, as shown in Figure 9.

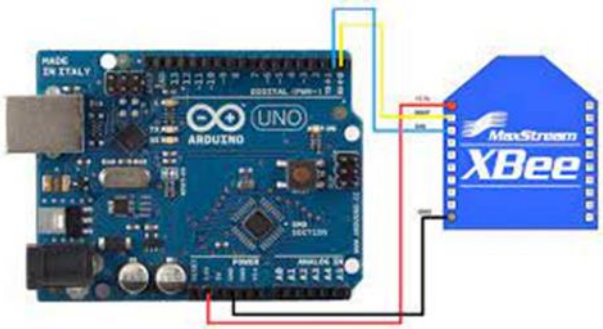

Fig 9. XBEE connection.

For the interaction between the Logomatic module and the Weather Kit, both earths (GND) were connected as shown with the orange color and the RX of the datalogger with the TX of the Arduino [9]. This is seen in gray in Figure 10.

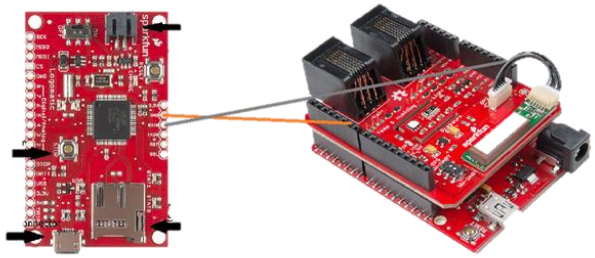

Fig 10. Datalogger connection to the Weather Shield.

As indicated on the Weather Shield card, the right side of this tablet connects the anemometer and the wind vane and on the left side the rain gauge [9], as shown in Figure 11.

Fig 11. Connection of the weather meter.

3.7 Using the SparkFun Logomatic v2 Module with Weather kit

The Arduino is programmed with the weather kit libraries, everything is connected, the datalogger is not connected before loading the program since it connects to the serial port and would not let the program load [9].

3.8 Full connection with the Weather kit

To complete the connection of this system, the battery is connected to the datalogger module and likewise, the microSD memory is connected, then the Arduino is turned on and the data logger, being the Weather Kit outside, begins to save in memory: the position, speed and direction of the wind, the amount of rain, the percentage of humidity and the overall temperature and positioning [9][10]. See Figure 12.

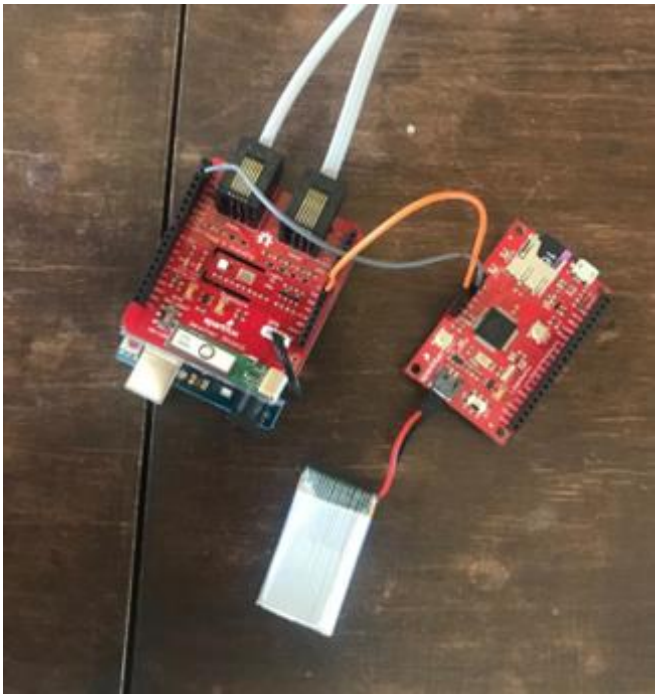

Fig 12. Full connection with the Weather Kit.

4. RESULTS

With the appropriated software loaded on Arduino, several cards were passed through the RFID connected to the datalogger, then the datalogger module was turned off and the microSD memory was removed, to then being inserted it into a computer using an adapter. It resulted, as expected, in a document of type .TXT with the digits of the scanned cards, as shown in Figure 13.

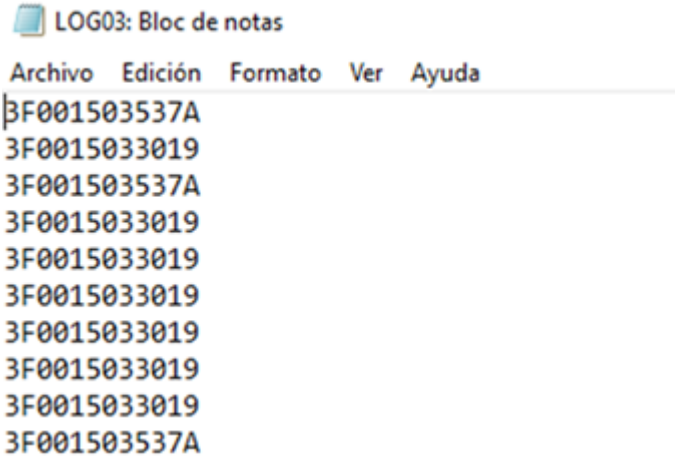

Fig 13. RFID registration.

The Arduino, Weather Kit, and datalogger were turned off to remove the microSD memory and open it on a computer, where the expected .TXT type file was found with the recorded data, it

is shown in Figure 14. In this case, this is the meteorological and positioning data provided by Sparkfun's Weather Shield module.

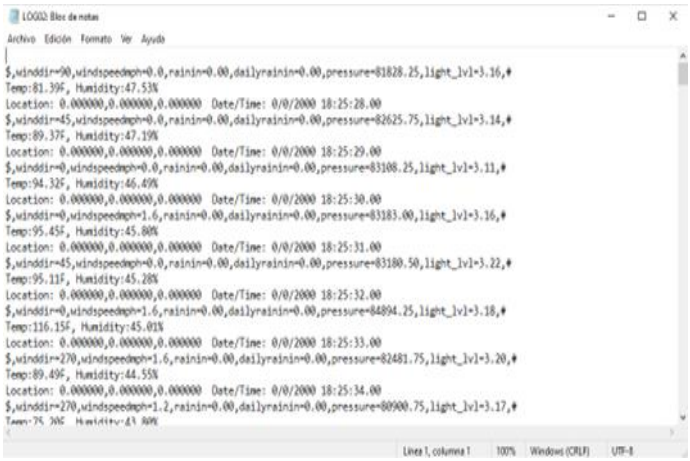

Fig 14. Weather records.

The XBEE module allowed wireless links of about 100m, which is useful for recording data in remote locations.

5. CONCLUSIONS

The datalogger alone is a very useful embedded system, but in conjunction with other embedded systems, the datalogger can be used in many other applications that require data logging without the need to be attending to them in that moment. An example is the case of the embedded RFID system, which records the activity in the warehouse through, allowing to monitor, measure, monitor the activity and giving the possibility of investigating failures and/or evaluating the system. In RFID it records the unique identification of ID cards. The Weather Kit records wind speed/direction, temperature, relative humidity and global positioning. Through the XBEE you have the possibility of registering remote stations. Likewise, the datalogger allows the possibility of specifying the record format, creating documents, not only of the .TXT type but others, such as Excel type. This project opens the possibility of applying datalogging technology in any process that merits the registration of information.

Acknowledgments

The authors are grateful to the TecNM/Instituto Tecnológico de Cd. Cuauhtémoc for the support for this research.

Bibliography

[1]. A.U. Iqbal (2020). Revista Europea de Ingeniería Eléctrica e Informática.
[2]. S.S. Kalpana (2012). Flying Object Travel Location Data Logger With 2GB MMC/SD Memory Card Using GPS for Aeronautical Applications Using PIC18F452 Microcontroller. International Journal of Engineering, Science and Mathematics.
[3]. M.I. Ratna Susana (2016). Interfaz periférica serie Penerapan Metoda (SPI) pada Rancang Bangun Data Logger berbasis tarjeta SD. Instituto Teknologi Nasional Bandung.
[4]. R.B. Oren Tirosh (2013). Wearable Textile Sensor Sock For Gait Analysis. Netanya, Israel.
[5]. I. Syad (2021). System Data Logger Dengan Memory SD Card Pada Alat Monitoring Tegangan, Arus, Intensitas Cahaya Dan Suhu. Sumatera Selatan, Indonesia.
[6]. Dewesoft (April 03, 2020). Obtained from https://dewesoft.com/es/daq/que-es-un-data-logger
[7]. Sparkfun. (s.f.). (2021). SparkFun Logomatic v2 - Registrador de datos en serie SD (FAT32). Recovered on October 04, 2021, from https://www.sparkfun.com/products/12772
[8]. Sparkfun. (s.f.). (2021). SparkFun Level Shifting microSD Breakout. Recovered on November 06, 2021, from https://www.sparkfun.com/products/13743
[9]. D. Sáenz-Zamarrón, N.I. Arana-de-las-Casas, L.N. Garay-Rojo. (2021). Environmental Monitoring through Embedded Systems. Congr. Int. en Ing. Electrónica. Mem. ELECTRO, Vol. 43 pp.113 - 119, Oct 2021, Chihuahua, Chih. México. ISSN 1405-2172. http:// electro.itchihuahua.edu.mx/revista
[10]. N.I. Arana-de-las-Casas, D. Sáenz-Zamarrón, M.A. Miranda-Castellanos. (2021). Global Positioning Satellite through Embedded Systems. Congr. Int. en Ing. Electrónica. Mem. ELECTRO, Vol. 43 pp.15 - 20, Oct 2021, Chihuahua, Chih. México. ISSN 1405-2172. http:// electro.itchihuahua.edu.mx/revista