FLYING OBJECT TRAVEL LOCATION DATA LOGGER WITH 2GB MMC/SD MEMORY CARD USING GPS FOR AERONAUTICAL APPLICATIONS USING 'PIC18F452 MICROCONTROLLER'

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ABSTRACT:

The paper aims in designing a system which is capable of logging the flying object travelled path into a MMC/SD card and later plots this in Google Earth application on PC. Global Positioning System (GPS) has been used in various commercial applications including transportation, navigation and vehicle position tracking, which when coupled with external memory stick the technology can help track the complete journey of any vehicle or moving objects like human or animals. This paper aims to construct a vehicle position logging system using GPS and SD/MMC (Secure Digital/Multi Media Card). The system comprises of following four modules. GPS Data Receiver,SD/MMC memory card interfacing,RS232 Interfacing. Data Processing (Microcontroller).The GPS data receiver module gets the data from 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 on to the SD/MMC card at the interval of two seconds. This data (At the end of the journey) is transferred to PC using RS232 communication. Data capturing is done by the HyperTerminal application on PC.This data

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is utilized by PC based application for displaying on a computerized map. This captured data is superimposed on the Google Earth map, which covers major cities and towns within India and abroad. The paper works satisfactorily in real time, can locate the flying object travel locations in the form of longitude, latitude with the margin of error not more than 6 meters from the actual location. This system also logs the information like date, time and speed information of the object.

Keywords: RS232, GPS, SD/MMC CARD,

I . INTRODUCTION TO EMBEDDED SYSTEM:

An **embedded system** is a special-purpose system in which the computer is completely encapsulated by or dedicated to the device or system it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few predefined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, benefiting from economies of scale.

Personal digital assistants (PDAs) or handheld computers are generally considered embedded devices because of the nature of their hardware design, even though they are more expandable in software terms. This line of definition continues to blur as devices expand. With the introduction of the OQO Model 2 with the Windows XP operating system and ports such as a USB port — both features usually belong to "general purpose computers", — the line of nomenclature blurs even more.

Physically, embedded systems ranges from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. In terms of complexity embedded systems can range from very simple with a single microcontroller chip, to very complex with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

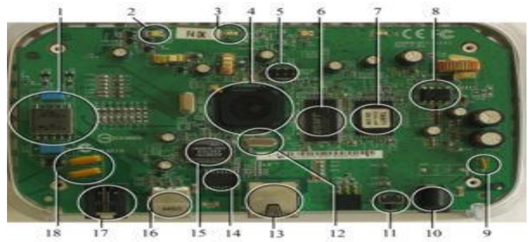


Figure 1.1: Embedded system configuration

2. Block diagram:

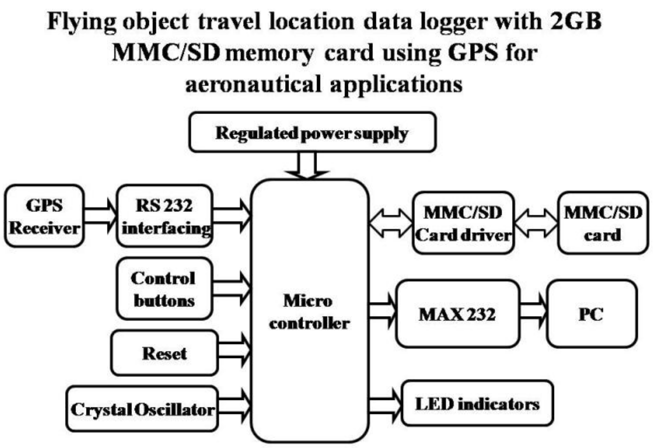


Figure 2.1: Block diagram

3. BLOCK DIAGRAM EXPLANATION:

The main blocks of this paper are:

1. Micro controller (18F452)
2. Reset button
3. Crystal oscillator
4. Regulated power supply (RPS)
5. LED indicator.
6. GPS module.

7. MMC/SD memory card

8. RS232 cable

3.1 Power supply:

In this system we are using 5V power supply for microcontroller of Transmitter section as well as receiver section. We use rectifiers for converting the A.C. into D.C and a step down transformer to step down the voltage.

3.2 PIC18F452 microcontroller: The pin configuration of the PIC18F452 microcontroller (DIP package).This is a 40-pin microcontroller housed in a DIL package, with a pin configuration similar to the popular PIC16F877. PIC18F2X2 microcontrollers are 28-pin devices, while PIC18F4X2 microcontrollers are 40-pin devices. The architectures of the two groups are almost identical except that the larger devices have more input-output ports and more A/D converter channels. In this section we shall be looking at the architecture of the PIC18F452 microcontroller in detail. The architectures of other standard PIC18F-series microcontrollers are similar, and the knowledge gained in this section should be enough to understand the operation of other PIC18F-series microcontrollers. Program memory addresses consist of 21 bits, capable of accessing 2Mbytes of program memory locations. The PIC18F452 has only 32Kbytes of program memory, which requires only 15 bits. The remaining 6 address bits are redundant and not used. A table pointer provides access to tables and to the data stored in program memory. The program memory contains a 31-level stack which is normally used to store the interrupt and subroutine return addresses.

The data memory bus is 12 bits wide, capable of accessing 4Kbytes of data memory locations. The data memory also consists of special function registers (SFR) and general purpose registers, all these are organized in banks.

The PIC18F452 consists timers/counters, capture/compare/PWM registers, USART, A/D converter, and EEPROM data memory. The PIC18F452 consists of:

1. 4 timers/counters
2. 2 capture/compare/PWM modules

3. 2 serial communication modules
4. 8 10-bit A/D converter channels
5. 256 bytes EEPROM

3.3 LED: A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. The internal structure and parts of a led are shown in figures 3.4.1 and 3.4.2 respectively.

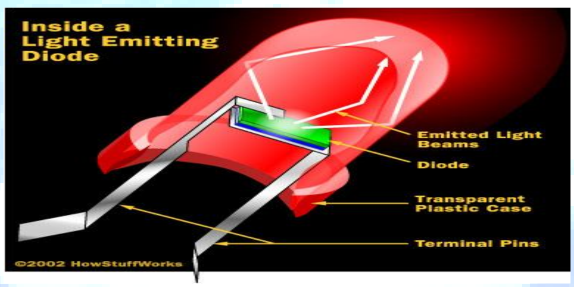


Fig 3.3.1: Inside a LED

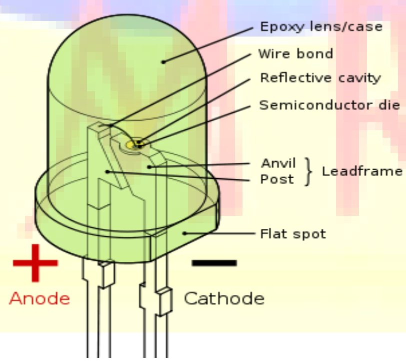


Fig 3.3.2: Parts of a LED

3.4 GPS MODULE (Global Positioning System):

The Global Positioning System (GPS) is a burgeoning technology, which provides unequalled accuracy and flexibility of positioning for navigation, surveying and GIS data capture. The GPS NAVSTAR (Navigation Satellite timing and Ranging Global Positioning System) is a satellite-based navigation, timing and positioning system. The GPS provides continuous three-dimensional positioning 24 hrs a day throughout the world. The technology seems to be beneficiary to the GPS user community in terms of obtaining accurate data up to about100 meters for navigation, meter-level for mapping, and down to millimeter level for geodetic positioning. The GPS technology has tremendous amount of applications in GIS data collection, surveying, and mapping.

The Global Positioning System (GPS) is a U.S. space-based radio navigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis -- freely available to all. For anyone with a GPS receiver, the system will provide location and time. GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world.

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day. There are no subscription fees or setup charges to use GPS.The GPS is made up of three parts: satellites orbiting the Earth; control and monitoring stations on Earth; and the GPS receivers owned by users. GPS satellites broadcast signals from space that are picked up and identified by GPS receivers. Each GPS receiver then provides three-dimensional location (latitude, longitude, and altitude) plus the time.

Individuals may purchase GPS handsets that are readily available through commercial retailers. Equipped with these GPS receivers, users can accurately locate where they are and easily navigate to where they want to go, whether walking, driving, flying, or boating. GPS has become a mainstay of transportation systems worldwide, providing navigation for aviation, ground, and maritime operations. Disaster relief and emergency services depend upon GPS for location and timing capabilities in their life-saving missions. Everyday activities such as banking, mobile phone operations, and even the control of power grids, are facilitated by the accurate timing provided by GPS. Farmers, surveyors, geologists and countless others perform their work more efficiently, safely, economically, and accurately using the free and open GPS signals.

3.5 MMC/SD memory card: The Multimedia Card (MMC) is a flash memory card standard. A memory card or flash memory card is solid-state electronic flash memory data storage device capable of storing digital contents.The MMC is the smallest removable flash memory designed specifically for digital applications, such as MP3 music players, digital video cameras, mobile phones, voice recorder, video game consoles, and other electronics. The Multi Media Card has a wide variety of uses in some of the most exciting products on the market today.

They offer high re-record-ability, power-free storage, small form factor, and rugged environmental specifications. There are also non-solid-state memory cards that do not use flash memory, and there are different types of flash memory. Many cards incorporate wear leveling algorithms in their design**.**One-time programmable (OTP) versions of the card are also available. Multimedia Cards (MMCs) are noted for their high transfer rates, up to 52 MB/sec.

MMC is about the size of a postage stamp: 24 mm x 32 mm x 1.4 mm. MMC originally used a 1-bit serial interface, but newer versions of the specification allow transfers of 4 or sometimes even 8 bits at a time. They have been more or less superseded by Secure Digital cards (SD card), but still see significant use because MMCs can be used in most devices that support SD cards.

An MMC is used as storage media for a portable device, in a form that can easily be removed for access by a PC. For example, a digital camera would use an MMC for storing image files. With an MMC reader (typically a small box that connects via USB or some other serial connection, although some can be found integrated into the computer itself), a user could copy the pictures taken with the digital camera off to his or her computer. Modern computers, both laptops and desktops, often have SD slots, which can additionally read MMCs if the operating system drivers support them.

MMCs are currently available in sizes up to and including 32 GB. They are used in almost every context in which memory cards are used, like cellular phones, digital audio players, digital cameras and PDAs. Since the introduction of Secure Digital card and SDIO (Secure Digital Input/output) slot few companies build MMC slots into their devices (an exception is some mobile devices like the Nokia 9300 communicator, where the smaller size of the MMC is a benefit), but the slightly thinner, pin-compatible MMCs can be used in almost any device that supports SD cards if the software/firmware on the devices support them.

The SD card is asymmetrically shaped in order not to be inserted upside down, while an MMC would go in most of the way but not make contact if inverted.

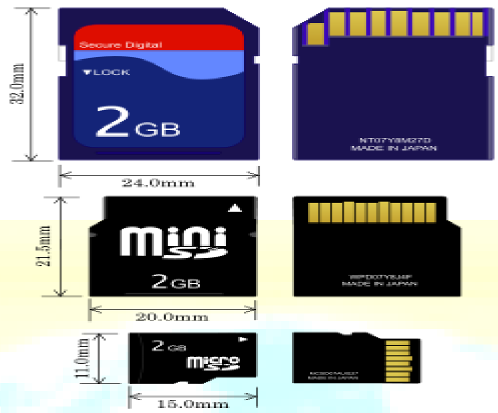
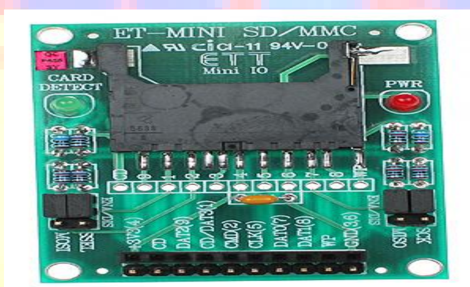
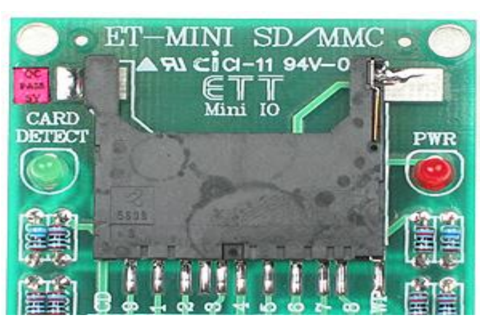


Fig3.5.1: An SD card, mini SD card, and micro SD card from top to bottom.

3.5.2 SD/MMC Mini Board:

Our new SD/MMC Mini Board is a great way to interface to a standard SD or MMC memory card. This board features a standard SD/MMC connector for easy connection of your memory card. Data can be easily downloaded or read from the card using standard SD or SPI communication.





3.6 RS 232 &MAX 232: RS232 means recommended standard, it is a cable in which serial communications can be done. Information being transferred between data processing equipment and peripherals is in the form of digital data which is transferred in either a serial or parallel mode. Parallel communications are used mainly for connections between test instruments or computers and printers, while serial is often used between computer and other peripherals.

Serial transmission involves the sending of data one bit at a time, over single communications line. In contrast, parallel communications require at least as many lines as there are bits in a word being transmitted (for an 8-bit word, a minimum of 8 lines are needed) serial transmission is beneficial for long distance communications, where as parallel is designed for short distance or when very high transmission rates are required.

The RS-232 interface is the Electronic Industries Association (EIA) standard for the interchange of serial binary data between two devices. It was initially developed by the EIA to standardize the connection of computers with telephone line modems. The standard allows as many as 20 signals to be defined, but gives complete freedom to the user. Three wires are sufficient: send data, receive data, and signal ground. The remaining lines can be hardwired on or off permanently. The signal transmission is bipolar, requiring two voltages, from 5 to 25 volts, of opposite polarity.

Fig: 3.6 RS 232 cable

4. Procedural steps for compilation, simulation and dumping:

For PIC microcontroller, PIC C compiler is used for compilation. The compilation steps are as follows:

- Open PIC C compiler.

You will be prompted to choose a name for the new project, so create a separate folder where all the files of your project will be stored, choose a name and click save.

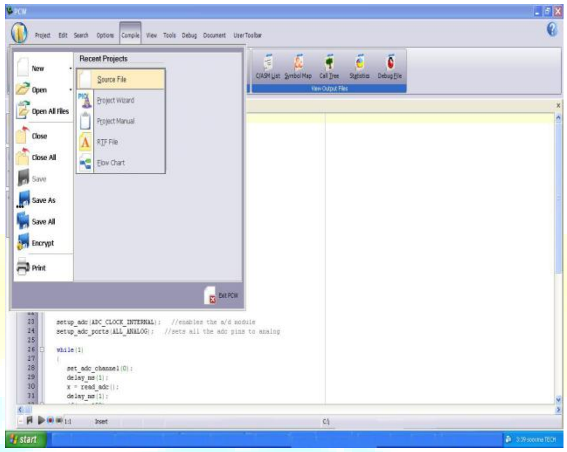


Fig 4.1: Picture of opening a new file using PIC C compiler

- Click **Project, New**, and something the box named 'Text1' is where your code should be written later.
- Now you have to click 'File, Save as' and choose a file name for your source code ending with the letter '.c'. You can name as 'project.c' for example and click save. Then you have to add this file to your project work.

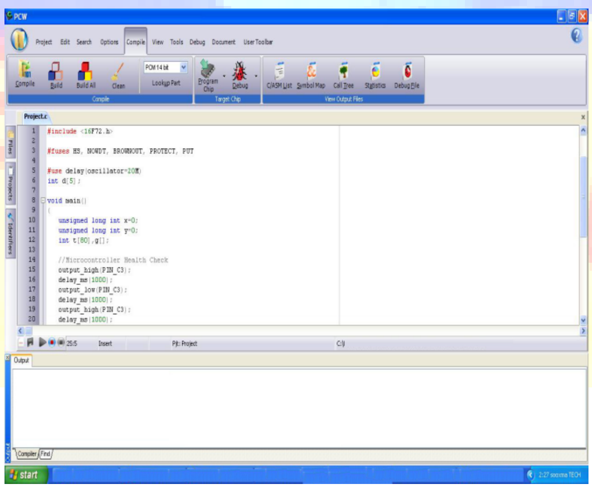


Fig 4.2: Picture of compiling a new file using PIC C compiler

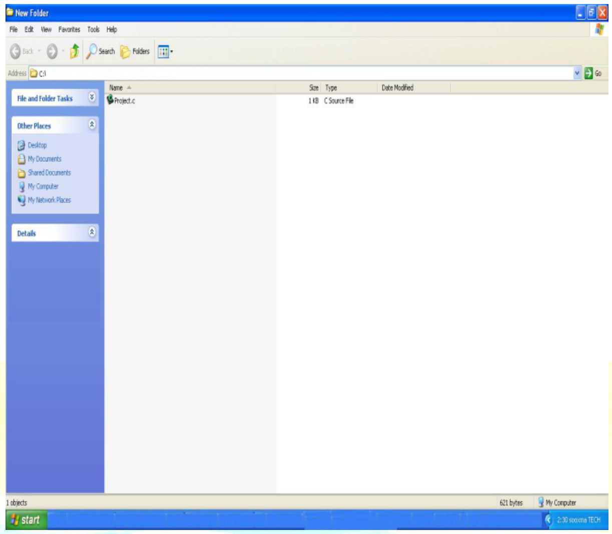
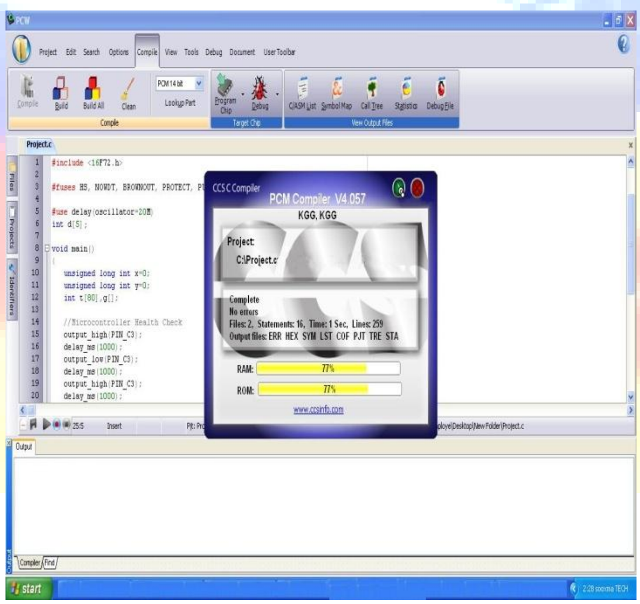


Fig 4.3: Picture of compiling a project.c file using PIC C compiler

- You can then start to write the source code in the window titled 'project.c' then before testing your source code; you have to compile your source code, and correct eventual syntax errors.



4.4: Picture of checking errors and warnings using PIC C compiler

- By clicking on compile option .hex file is generated automatically.

- This is how we compile a program for checking errors and hence the compiled program is saved in the file where we initiated the program.

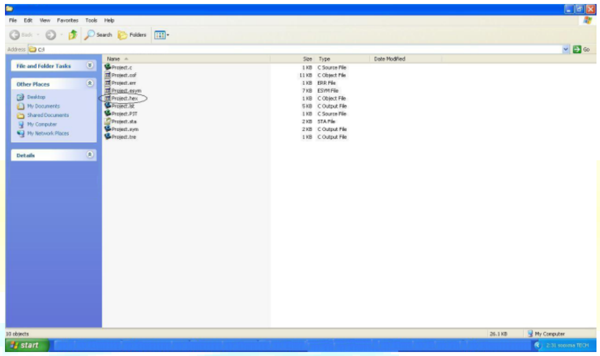


Fig 4.5: Picture of .hex file existing using PIC C compiler

After compilation, next step is simulation. Here first circuit is designed in Express PCB using Proteus 7 software and then simulation takes place followed by dumping. The simulation steps are as follows:

- Open Proteus 7 and click on IS1S6.
- Now it displays PCB where circuit is designed using microcontroller. To design circuit components are required. So click on component option.
- Now click on letter 'p', then under that select PIC18F452 ,other components related to the project and click OK. The PIC 18F452 will be called your "*'Target device", *which is the final destination of your source code.

4.4.2 Dumping steps:

The steps involved in dumping the program edited in proteus 7 to microcontroller are shown below:

Initially before connecting the program dumper to the microcontroller kit the window is appeared as shown below

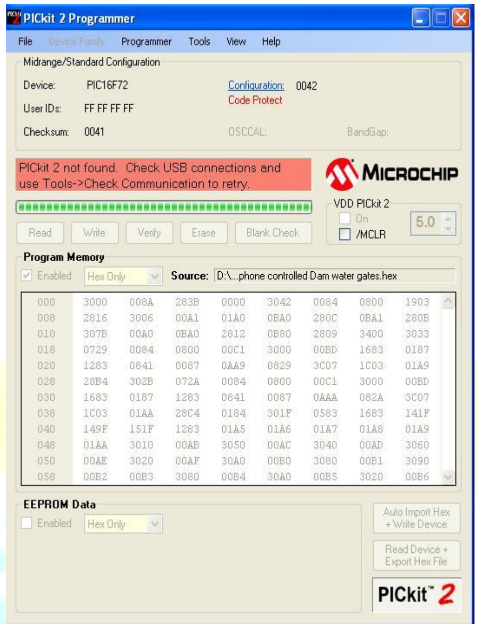


Fig 4.6: Picture of program dumper window

1. Select Tools option and click on Check Communication for establishing a connection as shown in below window

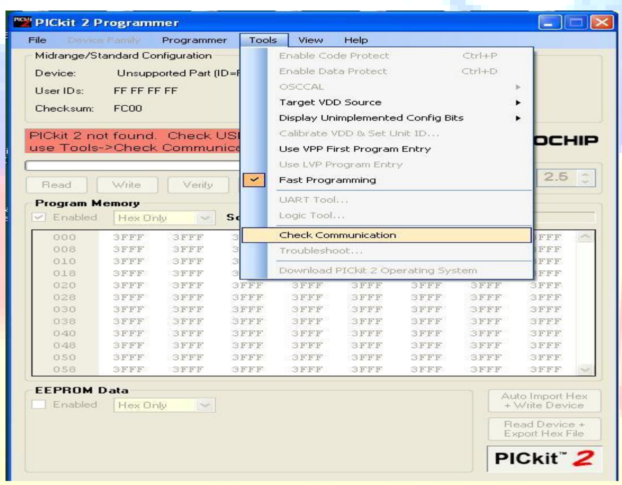


Fig 4.7: Picture of checking communications before dumping program into microcontroller

3. After connecting the dumper properly to the microcontroller kit the window is appeared as shown below.

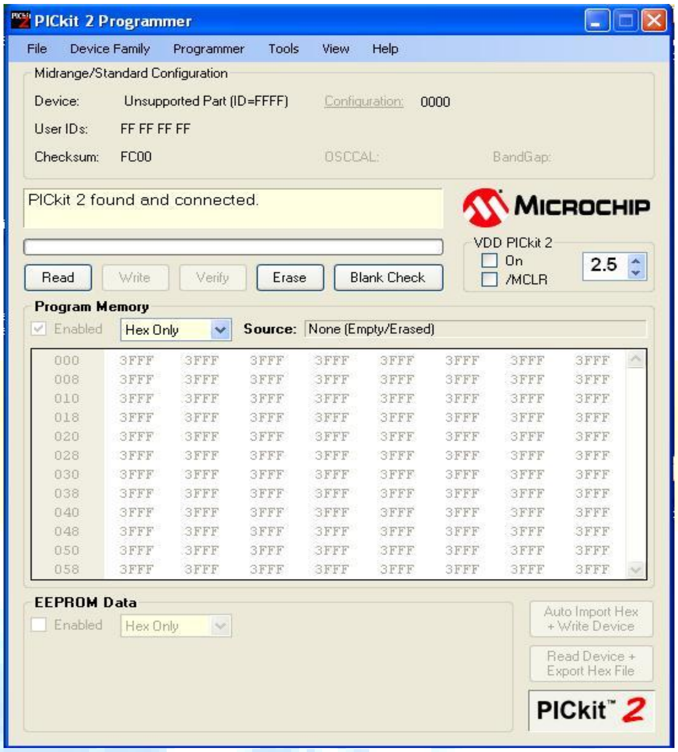


Fig 4.8: Picture after connecting the dumper to microcontroller

4. Again by selecting the Tools option and clicking on Check Communication the microcontroller gets recognized by the dumper and hence the window is as shown below.

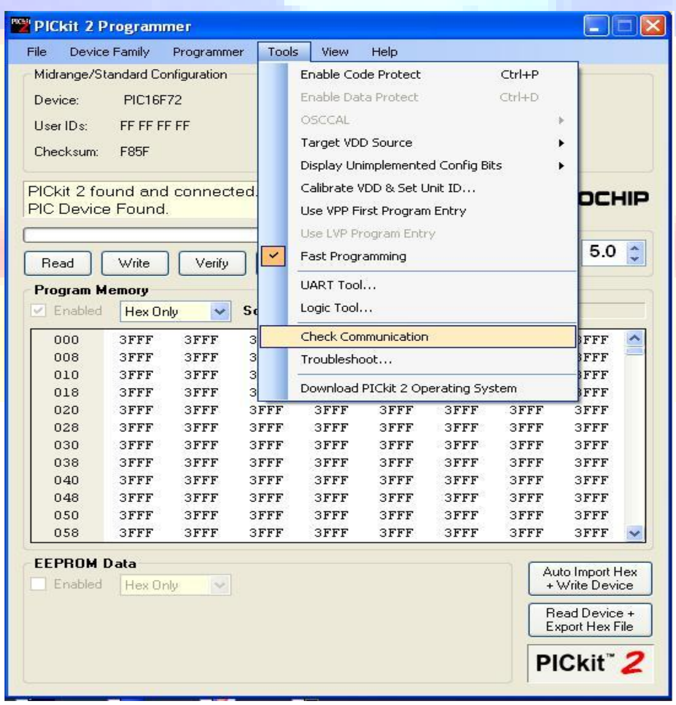


Fig 4.9: Picture of dumper recognition to microcontroller

5. Import the program which is '.hex' file from the saved location by selecting File option and clicking on 'Import Hex' as shown in below window

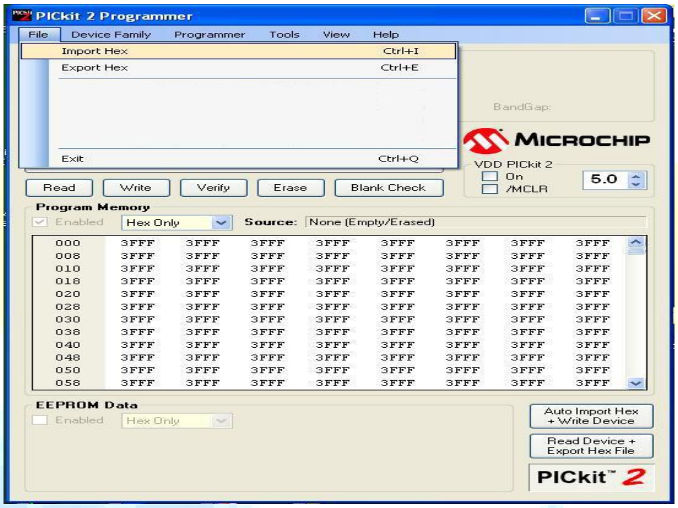


Fig 4.10: Picture of program importing into the microcontroller

6. After clicking on 'Import Hex' option we need to browse the location of our program and click the 'prog.hex' and click on 'open' for dumping the program into the microcontroller.

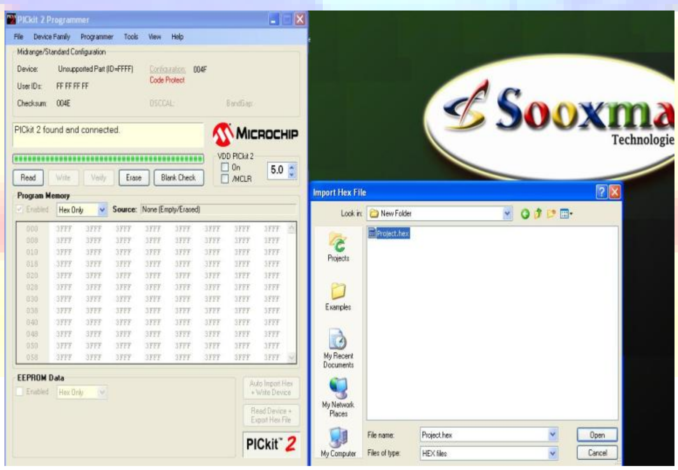


Fig 4.11: Picture of program browsing which is to be dumped

7. After the successful dumping of program the window is as shown below.

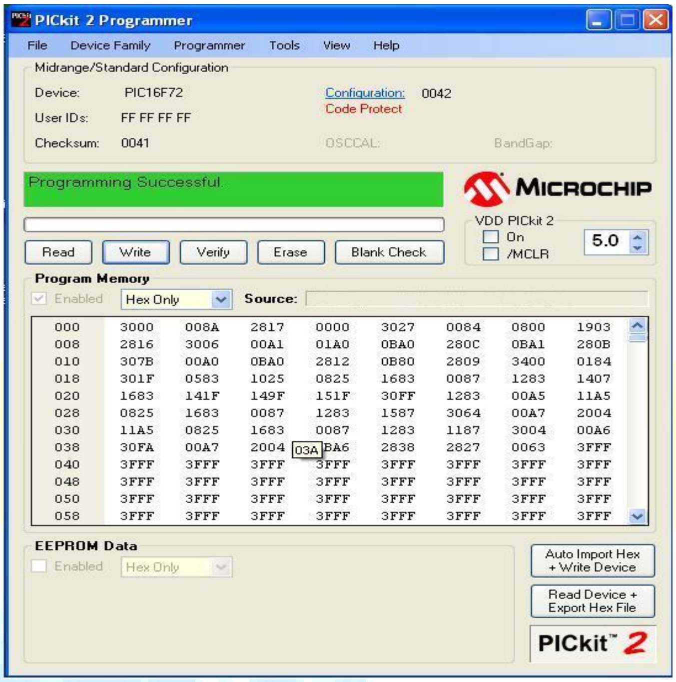


Fig 4.12: Picture after program dumped into the microcontroller

5. CONCLUSION:

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the paper has been successfully implemented. Thus the paper has been successfully designed and tested .

Our paper "**Flying object travel location data logger with 2GB MMC/SD memory card using GPS for aeronautical applications**" is mainly intended to find the location and the position of the vehicle/object using GPS and also logging the data in the MMC memory card. The GPS data receiver module gets the data from 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 on to the SD/MMC card at the interval of two seconds. This data (At the end of the journey) is transferred to PC using RS232 communication.

Data capturing is done by the HyperTerminal application on PC. This data is utilized by PC based application for displaying on a computerized map. This captured data is superimposed on the Google Earth map, which covers major cities and towns within India and abroad.

This paper can be extended using high efficiency GPS receiver and a GSM module. The GSM module gives the intimation of the person with this system through SMS.

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