# Make your own GPS Transmitter with HC-12 Transceiver

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***Abstract*—The most promising and fully operational GPS (Global Positioning System) is a navigation system based on a group of 24 satellites developed by U.S. Department of Defence. Every satellite sends data to the receiver in the form of signals, having some information about satellite and orbital information. Even in worst weather conditions this GPS system is used to find out exact location with respect to timing information anywhere on the surface of globe. The HC-12 can transmit the information from a GPS receiver with no additional programming or circuitry. Remotely transmitted coordinates would have to be received by another HC-12 transceiver and then processed with a microcontroller or computer.HC-12 is wireless transceiver (43.3Mhz) which is used to transmit a data up to long range (˜1.5km ) outdoor. Controller system is design on AVR controller system to process data from GPS and sends it to HC-12 receiver. On receiver side GPS receive data is decoded and send to the pc USB port. A interface unit (TTL to USB) is used between controller and pc.**

***Keywords* - GPS (Global Positioning System). HC-12 transceiver, AVR (Aboriginal Voices Radio), Controller System, decoding**

## I. INTRODUCTION

The HC-12 wireless serial port communication module is a new generation of multi-channel embedded wireless data transmission module. Its wireless working frequency band is 433.4-473.0MHz. Multiple channels can be set, with a channel stepping of 400kHz and a total of 100 channels. The maximum transmitting power of the module is 100mW (20dBm), the receiving sensitivity is -117dBm at a baud rate of 5000bps in the air. Communication distance is 1000m (FU3 mode at 4800bps serial speed) in open space, 1800m in FU4 mode at reduced baud rate and volume of data. The module uses stamp hole packaging to allow for patch soldering, with dimensions of 27.8mm ×14.4mm ×4mm (including antenna cap, excluding spring antenna), making it is very convenient for incorporate into user specific applications. There is a PCB antenna socket ANT1 on the module, so an external 433MHz frequency band antenna can be attached via a coaxial cable; there is also an antenna solder eyelet ANT2 on the module, convenient to solder a spring antenna to. Select one of these antenna options according to usage requirements.

The module has an onboard MCU, eliminating the need for user to program the radio section separately, with transparent half-duplex serial transmission provided for receiving and sending serial port data. This making the HC-12 very easy to interface with. The module adopts multiple serial port transparent transmission modes that are user selected by AT commands according to usage requirements. The average working current of the four modes FU1, FU2, FU3, and FU4 in idle state are: 3.6mA, 80uA, 16mA, and 16mA respectively, while the maximum working current in any mode is 100mA (in the transmitting state).

The HC-12 can transmit the information from a GPS receiver with no

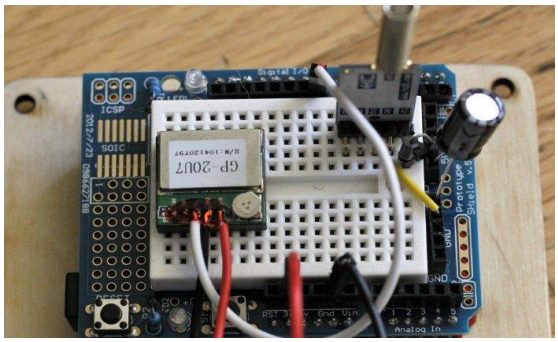

Fig.1: GPS transmission Using HC-12 Transmitter

Additional programming or circuitry. You can transmit GPS coordinates to remote locations with as little as a GPS receiver, an HC-12 transceiver, and a battery. Remotely transmitted coordinates would have to be received by another HC-12 transceiver and then processed with a microcontroller or computer.HC-12 is wireless transceiver (43.3Mhz) which is used to transmit a data up to long range (˜1.5km ) outdoor. Controller system is design on AVR controller system to process data from GPS and sends it to HC-12 receiver. On receiver side GPS receive data is decoded and send to the pc USB port. An interface unit (TTL to USB) is used between controller and pc. On pc it will be developing windows based software to display location information in Visual Basic 6.0.

## II. LITERATURE SURVEY

In Automated Driving Test system [1] paper presents about the automation of driving license test system. Normally, in driving test a candidate applied for license have to drive over a closed loop path in front of the authorities. The candidate has to drive over the path with specific rules and if he fails to do he will be disqualified. For that, the authorities watch candidate manually. In this project, the arduino system with sensors has been developed for watching the candidate for getting license. By using this, the candidate who fails to attain criteria in the vehicle on track, the sensors can be monitored then it was processed by another Arduino system connected to laptop or PC. The registered person entering for license test will be authenticated by using finger print sensor. So that they will automatically select or reject by the system. In recent days life technology has been developed and the growing technology introduces many advances in day to day life. This project helps to get driving license for the candidate without any biased interference of authorities.

The automated driving license test track is designed in all the possible driving challenges on the track that one might face on the road. It assesses the overall traffic knowledge and driving skills of applicants on the automated track through sensors. In this project IR sensors are used on the track to monitor the vehicle movement and tests driving skills of the candidate. And also the authority person needs not to monitor the candidate who enters for the license test. Before entering for the driving license test candidate has to be registered and authenticated using fingerprint sensor. During driving the person is monitored by the sensors. The Arduino monitors various sensors and verifies sensor readings with preset criteria and generates the results, which will be displayed on the computer. If candidate gets qualified he can get license. Suppose if the candidate fails to drive properly then that test is postpone for next particular day.

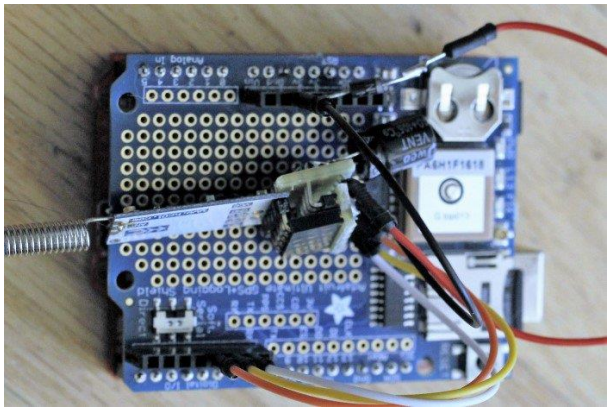

Fig. 2: GPS transmission Using HC-12 Receiver section

In another paper title of Global GPS data analysis at the National Geodetic Survey [2] NOAA's National Geodetic Survey (NGS) has been one of the Analysis Centres (ACs) of the International GNSS Service (IGS) since its inception in 1994. Solutions for daily GPS orbits and Earth orientation parameters are regularly contributed to the IGS Rapid and Final products, as well as solutions of weekly station positions. These solutions are combined with those of the other ACs and then the resultant IGS products are distributed to users. To perform these tasks, NGS has developed and refined the Program for the Adjustment of GPS Ephemerides (PAGES) software. Although PAGES has continuously evolved over the past 15 years, recent efforts have focused mostly on updating models and procedures to conform more closely to IGS and the International Earth Rotation Service (IERS) conventions. Details of our processing updates and demonstrations of the improvements will be provided.

Today, the Global Positioning System (GPS), operated by the United States government, is one of two functioning Global Navigation Satellite Systems (GNSS); GLONASS, operated by the Russian Federation government, is the other system. A third system, GALILEO, to be operated by the European Union, is expected to be functional by 2013, and China is presently developing a fourth system called Compass. Currently, there are about 29–32 usable GPS satellites broadcasting radio signals toward Earth. The signals contain approximate and precise information about the satellite's position in its orbit around Earth. A result of its design, this constellation of GPS satellites provides at least four satellites at any moment in time as viewed from any point on the Earth's. The National Geodetic Survey (NGS) uses the approximate and precise information contained in the GPS signals to estimate the position of each satellite at 15-min intervals. In addition to GPS satellite orbits, other product switch are estimated include Earth Rotation Parameters (ERPs), weekly terrestrial reference frame coordinates and tropospheric zenith path delays.

Each day, NGS and seven other agencies (http://igscb.jpl.nasa.gov/organization/centers.html) distributed worldwide use the approximate and precise information collected at receivers in a global tracking network from the previous day to estimate the

GPS satellite orbits during the previous day. These daily solutions are provided to the International GNSS Service (IGS), which combines them with other ACs solutions to generate the IGS Rapid combined orbit (with 17-h latency). Each week, (currently) eight agencies use the approximate and precise information collected over a 7- day period but about two weeks earlier, to estimate more precisely the GPS satellite orbits during that 7- day period. These weekly solutions are also provided to the IGS, which combines them with other ACs solutions to generate the IGS Final combined orbit (10–14 day latency). Because the IGS Rapid and Final orbits are a geometric and statistical weighted combination (e.g.,Kouba et al. 1998) of the respective daily and weekly solutions from the eight IGS Analysis Centres, the precision of the IGS orbits depends on the combined precision of the individual solutions. The focus of this article is on summarizing the changes to the NGS GPS processing software and how the resulting NGS daily and weekly orbits compare to the IGS Rapid and Final orbits, respectively.

## III. PROPOSED SYSTEM

As shown in the above Figure 3, HC-12 module is used in physical wiring when replacing half duplex communication. The left device sends serial port data to module, and after RXD port of left module receives the serial port data, it will automatically send the data into the air via radio wave. The right module can automatically receive the data, and restore, from TXD, the serial port data originally sent by the left device. It is the same from right to left. Only half duplex state is available between modules, and they cannot receive and send data at the same time.

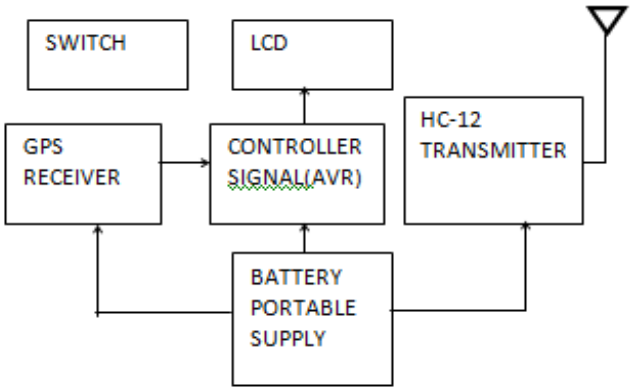


Fig. 3: Block diagram Of GPS transmission Using HC-12 Transmitter section

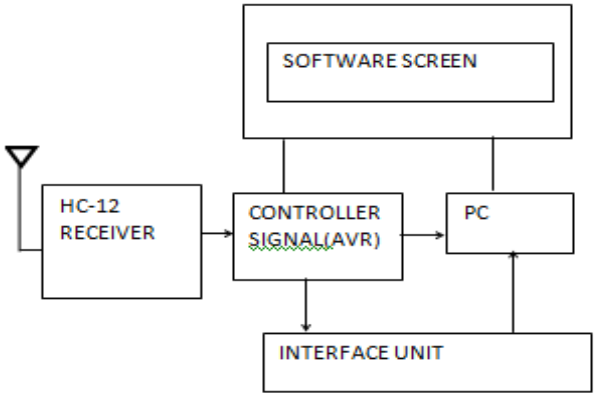


Fig. 4: Block diagram Of GPS transmission Using HC-12 Receiver section

HC-12 module has three serial port transparent transmission modes, expressed with FU1, FU2 and FU3 respectively. In the use, all modes are only responsible for receiving and sending serial port data rather than wireless transmission. The default working mode of system is in FU3 full-speed mode, and in this mode the baud rate in this air can be automatically adjusted according to baud rate of serial port, and the communication distance will be the farthest at the low baud rate as shown in Figure 4. Different modes cannot transmit data to each other, and user could select the optimal mode according to practical circumstances. The modules are usually used in pairs, and transmit data by means of half duplex. Meanwhile, the transparent transmission mode, serial port baud rate, and wireless communication channel of two paired modules shall be set to be the same. The default setting is FU3, 9,600bps (8-dibit data, no check, one stop bit), CH001 (433.4MHz). Use the number of bytes continuously sent to serial port of module unlimited to one time. However, considering ambient interference and other factors, if thousands of data size is sent continuously at a time, some number of bytes may be lost. Therefore, the upper computer shall have response and resending mechanism, to avoid information loss.

## IV. HARDWARE AND SOFTWARE USED

### A. Hardware Used:

1. HC-12 :

HC-12 wireless serial port communication module is a new-generation multichannel embedded wireless data transmission module. Its wireless working frequency band is 433.4-473.0MHz, multiple channels can be set, with the stepping of 400 KHz, and there are totally 100 channels. The maximum transmitting power of module is 100mW (20dBm), the receiving sensitivity is -117dBm at baud rate of 5,000bps in the air, and the communication distance is 1,000m in open space. The module is encapsulated with stamp hole, can adopt patch welding, and its dimension is 27.8mm × 14.4mm × 4mm (including antenna cap, excluding spring antenna), so it is very convenient for customers to go into application system. There is a PCB antenna pedestal ANT1 on the module, and user can use external

antenna of433M frequency band through coaxial cable; there is also an antenna solder eyeANT2 in the module, and it is convenient for user to weld spring antenna. User could select one of these antennas according to use requirements.

2. AVR Controller:

AVR is microcontroller families to use on-chip flash memory for program storage. The Atmel® pico Power® ATmega328/P is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328/P achieves throughputs close to 1MIPS per MHz This empowers system designer to optimize the device for power consumption versus processing speed.

3. GPS Module:

It works something like this: If we know our exact distance from a satellite in space, we know we are somewhere on the surface of an imaginary sphere with radius equal to the distance to the satellite radius. If we know our exact distance from two satellites, we know that we are located somewhere on the line where the two spheres intersect. And, if we take a third measurement, there are only two possible points where we could be located. By taking the measurement from the fourth satellite we can exactly point out our location. The Global Positioning System satellites transmit signals to equipment on the ground. Each GPS satellite transmits data that indicates its location and the current time.

4. Aurdino UNO R3:

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the Aduino UNO is the optibootbootloader.Boardsare loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods, when used with traditional microcontroller tools instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.

**B. Software Used:**

1. Embedded C:

The embedded system designers must know about the hardware architecture to write programs. These programs play prominent role in monitoring and controlling external devices. They also directly operate and use the internal architecture of the microcontroller, such as interrupt handling, timers, serial communication and other available features. The basic additional features of the embedded software

2. Aurdino:

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

3. Visual Basic 6.0:

Visual Basic is a tool that allows you to develop Windows (Graphic User Interface - GUI) applications. The applications have a familiar appearance to the user. Visual Basic is event-driven, meaning code remains idle until called upon to respond to some event (button pressing, menu selection). Visual Basic is governed by an event processor. Nothing happens until an event is detected. Once an event is detected, the code corresponding to that event (event procedure) is executed. Program control is then returned to the event processor.

## V. CONCLUSIONS

It need to have some realistic expectations when using this module. It work well when the receiver and transmitter are close to each other. If you separate them too far you'll loose the communication. The communication range will vary. It depends on how much voltage that you're supplying to your transmitter module, RF noise in your environment and if you're using an external antenna. By considering this signal, we can conclude that by using real time tracking with GRS assistance we can locate accurate position of deice in nearby area.

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