GPS Surveyor
Project FZ1605

This project uses two Global Positioning Satellite, (GPS), receivers to acquire position data for downloading to a portable computer which processes the data for applications which require precision not achievable from a single receiver. Two modules are used, with identical hardware, consisting of a GPS receiver and antenna, a ZigBee wireless transceiver and antenna, accelerometers, and a microcontroller, (MCU), with two serial ports for communication between the GPS receiver and the portable computer. The modules differ only in their software. The first module is at a fixed, known, reference location. Its MCU configures the transceiver as a transmitter to transmit the data from the GPS receiver to the second module, whose location is unknown and changing. The second module's MCU configures its transceiver as a receiver to receive the data from the first module. The second module can then download data from both receivers, allowing the portable computer to derive a position of greater accuracy using differential GPS, (DGPS), techniques. This technique has previously been used to improve GPS accuracies using special DGPS stations and DGPS receivers. This project's method takes advantage of this technique without the limitation of being within range of a DGPS station and requires no DGPS receiver.

Applications which can benefit from this improved accuracy include surveying, vehicle tracking over moderate distances, such as within a parking lot or race track, or any situation where a precise position is required within the range of the transceivers. This range, usually considered to be tens of meters, can be much greater based on the results of recent testing[1)] which has achieved effective ranges as great as several hundred meters. The addition of a receiver low noise amplifier or a higher gain antenna could extend this even further.

A limitation of GPS position data of the moving module concerns high speeds. Since the GPS update rate is only once per second, the distance covered during this time would result in undesirable gaps in the calculated position. To avoid this some means are necessary to interpolate between the positions of the one second updates. To accomplish this, the readings from the transceiver board accelerometers in three axes are sent to the computer at a higher rate allowing it to fill in the gaps with sufficient accuracy.

Code Sample

[1)]Freescale's ZigBee™ enabled platform achieves industry leading 378 meter range - RFDesign, 12-16-04.

```
;           This code sends data to the transceiver for transmittal
;           using the stream mode.

TX_GPS:     BSET  IRQACK,IRQSC      ; Clear interrupt pin.
            LDHX  #BUFF             ; Point H:X at the data buffer.
            BCLR  2,PTED            ; Set /SS low.
            TX_PK #$02              ; Load the port D data into RAM1.
            RD_RX #$86              ;
            BSET  4,TEMPH           ;
            WR_TX #$06,TEMPH,TEMPL  ; Enable the data stream.
            BSET  3,PTCD            ; RXTXEN = high.
TRANBUFF:   LDA   #250              ;
WT_IRQ:     BRSET IRQF,IRQSC,TX_IRQ ; Wait for the interrupt signaling the
            BCLR  2,PTED            ; end of the transmission. If it hasn't
            BCLR  2,PTED            ; occured within 1 msec, continue.
            DBNZA  WT_IRQ           ;
            BRA   NO_IRQ            ;
TX_IRQ:     BSET  IRQACK,IRQSC      ; Acknowledge and clear interrupt.
            TX_PK #$02              ;
            CBEQX #BUFF+76,NO_IRQ   ; Repeat until the whole message has
            BRA   TRANBUFF          ; been transmitted.
                                    ;
NO_IRQ:     BSET  IRQACK,IRQSC      ; Acknowledge and clear interrupt.
            RD_RX #$A4              ; Clear interrupt bits in status
register.
            RD_RX #$86              ;
            BCLR  4,TEMPH           ; Disable the data stream.
            WR_TX #$06,TEMPH,TEMPL  ;
            BCLR  3,PTCD            ; RXTXEN = low.
```

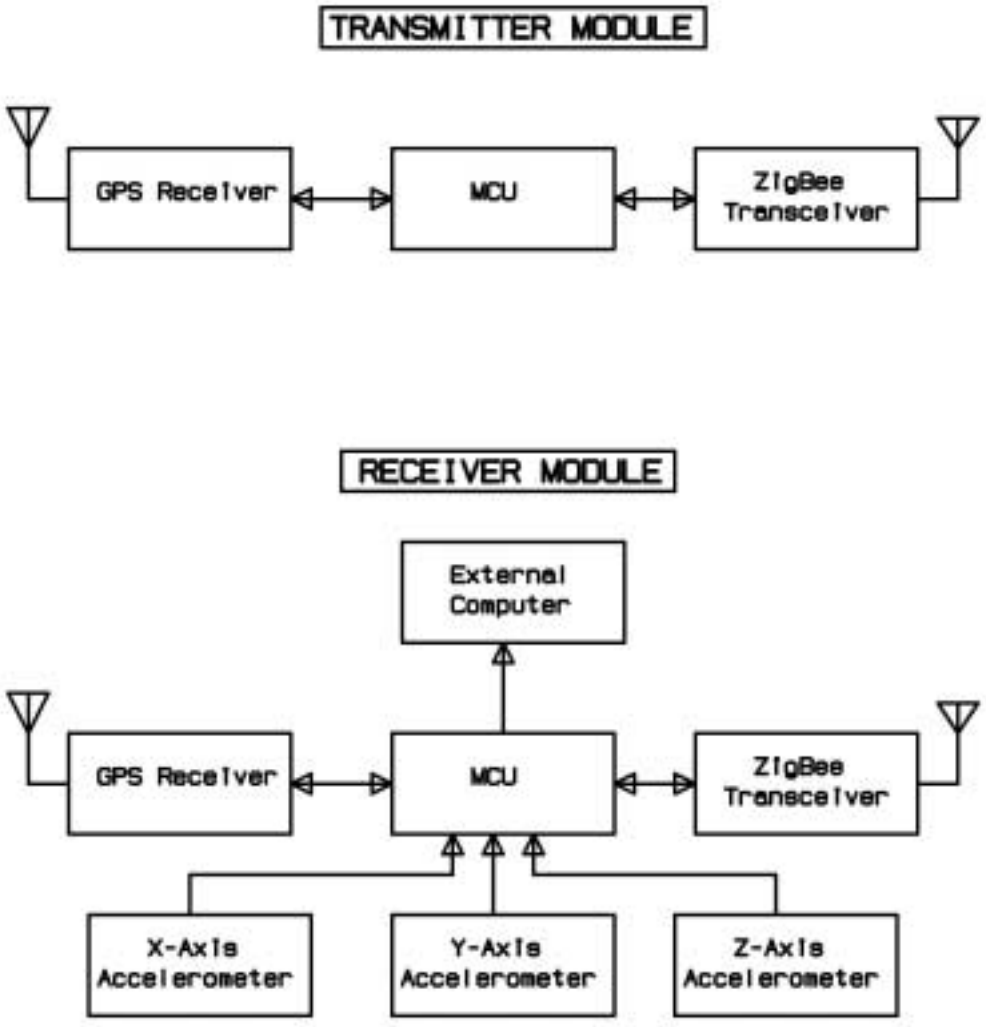

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Figure 4

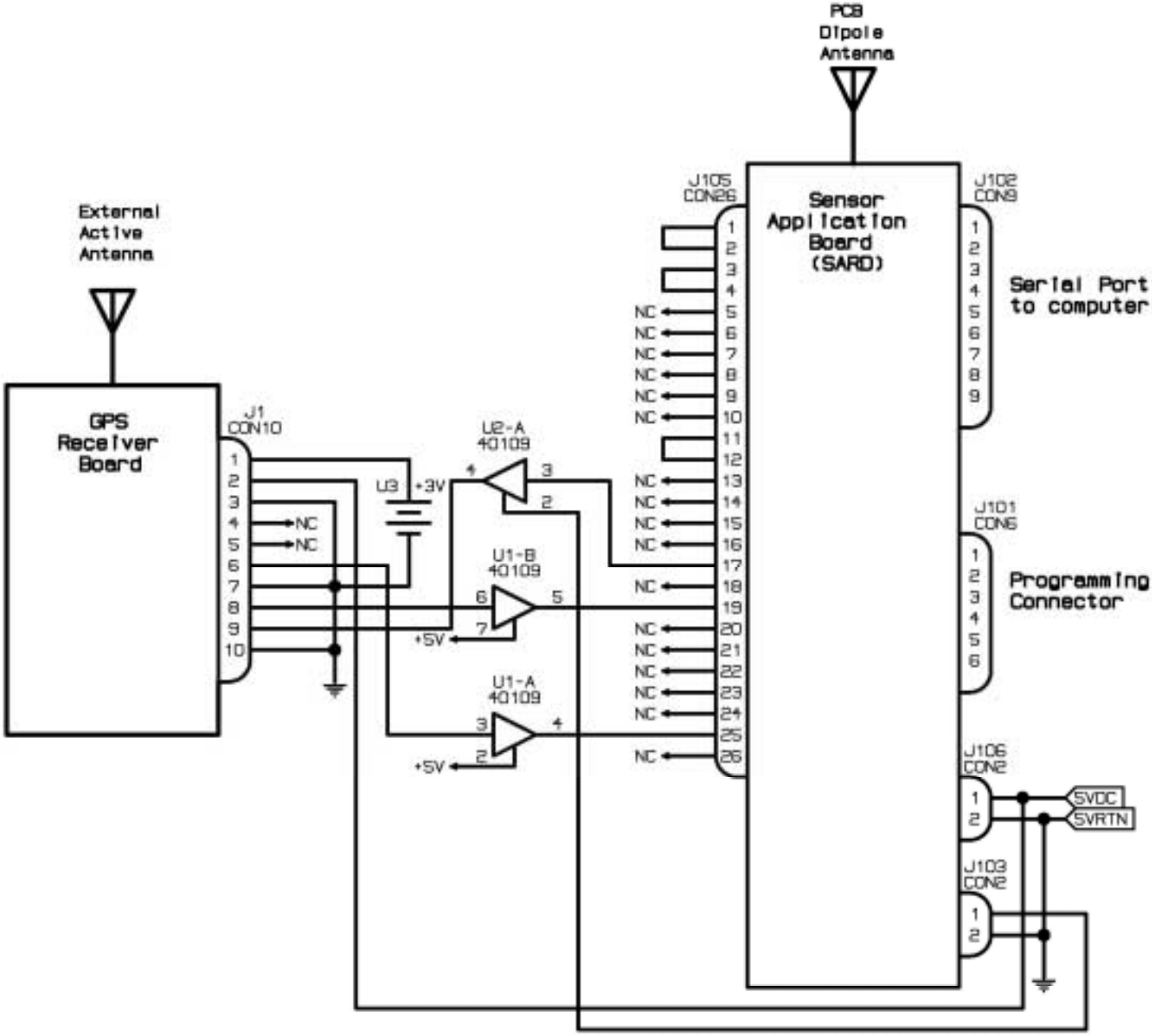

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Figure 3