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DEVELOPMENT OF AUTOPILOT FOR INDOOR AND OUTDOOR UNMANNED VEHICLES WITH AIDED NAVIGATION TECHNIQUES

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ABSTRACT

Unmanned vehicles (UVs) are used to aid humans in performing military and non-military tasks such as search and rescue, planetary exploration, reconnaissance, etc. UVs can be used for different purposes such as taking a passenger to a specific address, delivering some materials in dangerous environments, observing some particular places, etc. An unmanned ground vehicle (UGV) is a vehicle that operates while in contact with the ground and without an onboard human presence. UGVs can be used for many applications where it may be inconvenient, dangerous, or impossible to have a human operator present. Generally, the vehicle will have a set of sensors to observe the environment. The main requirements of these envisioned tasks are localization and navigation processes. The accuracy of these processes mainly depends on the algorithm and the sensors used for perception by UVs.

FreeRTOS based Autopilot board for UGV is composed and actualized. Here, the Autopilot load up has information lumberjack, which is utilized to peruse the ongoing information from the sensors which are interfaced to a processor and stores it in an outside memory. GPS module can be used to determine current location and timing parameters of UGV.

KEYWORDS – Unmanned Ground Vehicle, Inertial Measurement Unit, Inertial Navigation System

I.INTRODUCTION

In our day by day life there are situations where human vicinity might be badly designed, risky, unthinkable and perilous circumstances. Samples are explosives and bomb crippling vehicles. An atomic force plant additionally risky environment for human vicinity. We can have occurrence happened in Chernobyl atomic force plant. The fiasco started amid a frameworks test on Saturday, 26 April 1986 at reactor number four of the Chernobyl plant. As a consequence of atomic force plant reactor fiasco, 237 individuals experienced intense radiation affliction (ARS), of whom 31 passed on inside of the initial three months.

Military pioneers favored thought little units for pace and adaptability, to increment imperative information about the scene and enemy before sending the key (or prevailing part) troops into the region, screening, covering power, hobby and abuse parts. Skirmishing is a standard skill of perception, and moreover bullying of the enemy. Around then Officers may ambushed and executed by enemy powers. In rescue operations in like manner various commandants and general people lost their lives. One of such event is in Mumbai strike. No under 50 consistent residents lost their lives in the midst of the assault in the Taj. Thusly, Unmanned vehicles can be used in perception, observation, rescue operations and distinctive unsafe, amazing and hazardous environment for human region. Nevertheless, the issue arrives is the same course methodologies for indoor and outside unmanned vehicles. Our envisioned system overcomes the above issue by giving separate upheld course methods to indoor and outside unmanned vehicles.

II. INDOOR AND OUTDOOR NAVIGATION SYSTEMS

UVs can be used for different purposes such as taking a passenger to a specific address, delivering some materials in dangerous environments, observing some particular places, etc. The main requirements of these envisioned tasks are localization and navigation processes in indoor and outdoor. The accuracy of these processes mainly depends on the algorithm and the sensors used for perception by UVs. Sensors provide several measurements including the information such as direction, speed and position.

Aided Navigation System for Outdoor

Route framework for open ground unmanned vehicle utilizes GPS, IMU and INS estimations. The IMU without anyone else's input does not give any sort of route arrangement (position, speed, state of mind). it just impels as a sensor, in resistance to the INS, which incorporate the estimations of its inside IMU to give a route framework utilizes an IMU to shape an independent route framework which utilizes estimations gave by the IMU to track the position, speed and introduction of an article in respect to a beginning stage, introduction, and speed.

A. Aided Navigation System For Indoor

Navigation system proposed for indoor unmanned vehicles uses Thermal imaging camera, Ultrasonic and Infrared sensors for distance measurements and to detect obstacles.With the measurement data and camera mapping, localization and navigation performed. Using available measurement data RSSI measurement are made. measurements are based on the relationship between transmission distance and signal attenuation.

III. PROPOSED APPROACH

We are building so as to actualize the venture a vehicle module. This vehicle module comprises of two dc engines, an engine driver L293D, microcontroller, IR sensor, Ultrasonic, warm imaging camera, 9DOF IMU sensor and switches. Dc engines are utilized to move the vehicle development – forward, in reverse, right and left headings. In any case, the current supplied by the controller is not adequate for pivoting the dc engine. Subsequently, an intensifier L293D which opens up the current is utilized to create the adequate current. For the warning of Area, we are interfacing GPS module on vehicle through serial correspondence.

GPS is CMOS gadget and the controller is a TTL gadget. The last yield for all CMOS gadget is RS232. The inside voltage levels for CMOS gadgets are 18-23 volts. As the controller is a TTL gadget it works at 5 volts. With a specific end goal to change over the voltage levels from 18-23 to 5 volts we utilized MAX232 which goes about as enhancer.

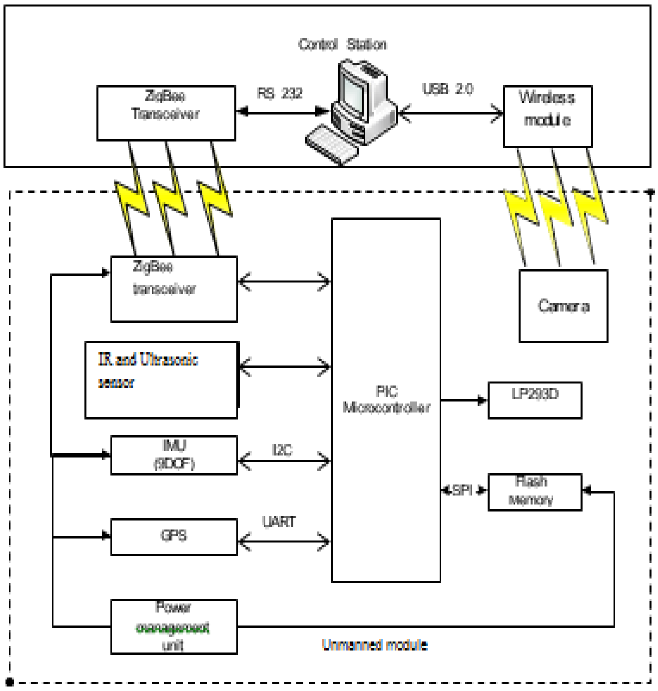

Fig. 1. Autopilot controller board with Control Station

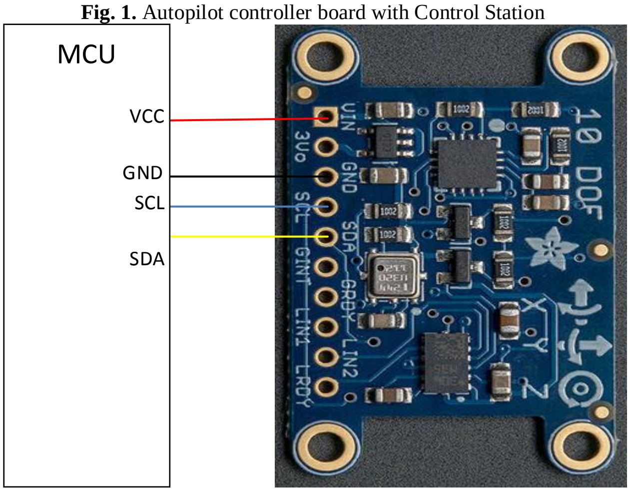

Fig.2 DOF –IMU Sensor Wiring

Modules which are associated with the processor are takes after

- Personal PC.
- 9DOF IMU.
- Infrared sensor.
- Ultrasonic sensor.
- Microcontroller.
- GPS module.
- Thermal imaging camera.
- Battery.

IV SIMULATION

In logical analyzer we will observe the communication between the master (MCU) and slave (BMP) by using I2C protocol as shown in Figure 2. From the logic analyzer data we can see from output signal that total time taken for data reading. From figure 6 we can observe Execution time for all sensors using Logic Analyzer. Green dotted lines indicates that total time that is taken for reading sensor data. Figure 8 Timing Plot I2C communication shown in logical analyzer This timing analysis helps us to understand the total period that I2C takes to read the sensor data and frequency rate at which instruction are executing. From these values such as velocity, and altitude the autopilot controller can understand.

The gear set up for interfacing Inertial Estimation unit or Inertial Estimation unit (IMU) Sensor furthermore called as 9-DOF MPU sensor used to process accelerometer qualities and Spinner values which along these lines used to figure the pitch, roll, and height required controlling and investigating the UGV. To learn these qualities we use the MPU sensor. Interfacing of this sensor with master appraisal board is done using I2C tradition; sensor interfacing purposes of enthusiasm of I2C is showed up in Figure 2.

Figure 6 demonstrates the execution time for all sensors utilizing rationale analyzer. Incorporates MPU, IR and Ultra sensors execution time, which examines the timing plot to decrease delay and to know whether there is need of overhauling the sensors, there working capacity. GPS Area following is appeared in figure 4. Gives the way in which UGV went with help of longitude, elevation, scope, timing information.,etc.

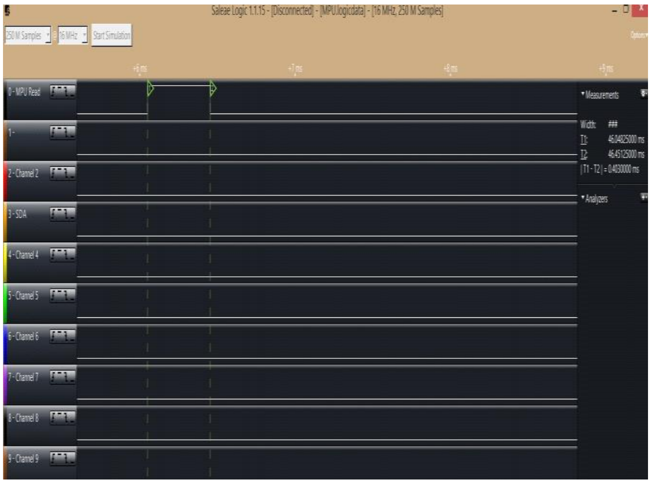

Fig. 3 Execution time for MPU sensor using Logic Analyzer

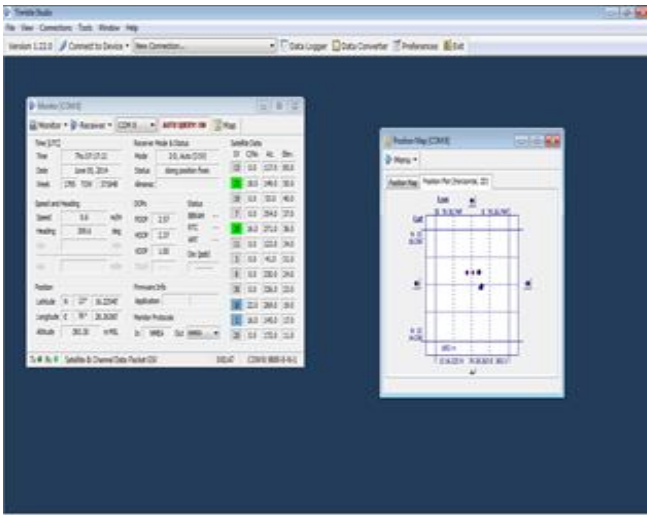

Fig.4 GPS Location tracking

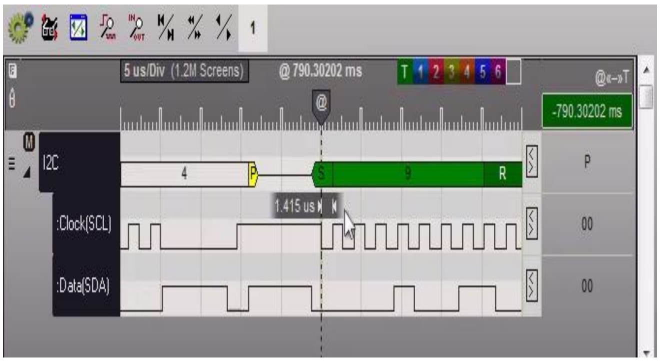

Fig.5 Timing Plot I2C communication shown in logical analyzer

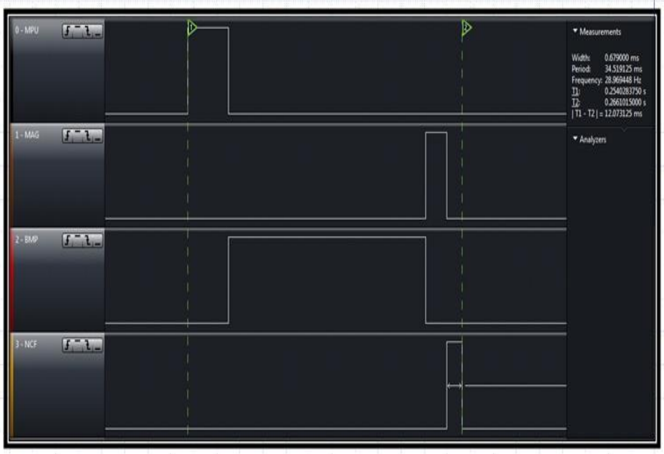

Fig. 6 Execution time for all sensors using Logic Analyzer

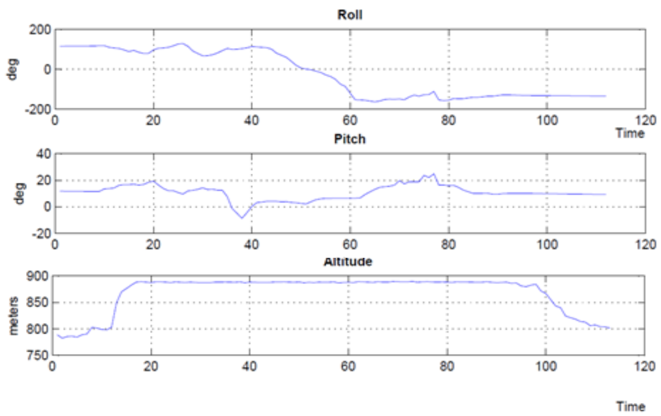

Fig. 7 pitch, roll and altitude from logged data

VI CONCLUSION

The FreeRTOS based autopilot developed with PIC controller is interfaced to the following sensors

- IMU
- IR Sensor
- Ultrasonic Sensor
- GPS

Experimental studies were conducted to prove the methods effectiveness. The results of simulation studies show that for fusing information from an external absolute sensor improves the accuracy of autopliot based navigation in both outdoor and indoor environments. The interfacing with RC receiver and RF link for connection with Control S could not be done due to the shortage of time.

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