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Design and development of communication system for ship using IOT

Prof. S.R.Rohile[1], Gadge Sayali Sanjay[2] Kadam Rutuja Sanjay [3], Belote Sonali Dayanand [4]

[1]Assistant professor, [2]student, [3]student, [4] Student

[2]Department of Electronics and telecommunication engineering, Samarth group of institutions college of engineering, Belhe, India

Abstract: *Packet data networks at sea offer the potential for increased safety, connectivity and meteorological data acquisition. Existing solutions including satellite communication are expensive and prohibitive to most small vessels. In this paper, an Internet of Things (IoT) application is proposed as a marine data acquisition and cartography system over Ship Ad-hoc Networks (SANET). Ships are proposed to communicate over Very High Frequency (VHF) which is already available on the majority of ships and are equipped with several sensors such as sea depth, temperature, wind speed and direction, etc. On shore, 5G base station nodes represent sinks for the collected data and are equipped with Mobile Edge Computing (MEC) capabilities for data aggregation and processing.*

Keywords *- AVR Microcontroller, fuel leakage and fire sensor,3-axis accelerometer,IOT.*

I. INTRODUCTION

A mobile Ad Hoc Network (MANET) is a system of mobile nodes which are connected by wireless links. Each of these nodes acts as a router and is free to move in any direction independently. MANETs are a popular telecommunication technology that can easily be applied to almost any environment having fast configuration and no need for any underlying infrastructures support. The popularity of MANETs is due to the wide range of available wireless services and increasing spread of communicating devices like cell phones, laptops, PDAs, etc., providing ubiquitous computing at low cost. Networks in the marine environment are not as mature as land-based wireless systems. Marine communication systems available today only provide the bare minimum essential services such as ship identification, positioning, location, course, heading, destination, tonnage, speed, etc… in the form of AIS (Automatic Identification System) using VHF radio frequencies. Inter ship satellite communication is possible but is a costly option when compared to conventional wireless communications and not affordable by most small to medium seagoing vessels [1].In efforts to standardize VHF data network communication at sea, the international telecommunication union (ITU) has defined Recommendation ITU-R M.1842-1".

The Characteristics of VHF Radio Systems and Equipment for the Exchange of Data and Electronic Mail in the Maritime Mobile Service Radio Regularization (RR) Appendix 18 Channels" [2]. They have defined marine band VHF radio to operate on internationally agreed frequencies in the band from 156MHz to 163MHz. They also provide a guideline on the use of digital technologies by VHF systems of different bandwidths [3]. As expansion of the 5G radio spectrum, Ofcom has allocated VHF spectrum for the Internet of Things (IoT), aiming to encourage Machine to Machine (M2M) applications to use spectrum that will enable them to connect wirelessly over distances that are not possible with other frequencies. In this paper, we propose an Internet of Things (IoT) application as a marine data acquisition and cartography system over Ship Ad-hoc Networks (SANET). We extend our evaluation of the Ship Ad-hoc Network proposed in [4] [5] to IoT networks and discuss the limitations and benefits of the proposed application and network architecture. We use a model of the VHF radio that complies with the ITU standards for data communication in the marine environment to setup a physical layer in the NS2 simulator. We use Time division multiple access (TDMA) as the channel access method as proposed by the ITU for ship data communication over VHF channels. TDMA allows a number of users to use the same frequency channel by dividing the signal into several different time slots. The users transmit in rapid sequence, one by one, each using its unique time slot. We investigate the performance of four different MANET routing protocols which are Ad hoc On-Demand Distance Vector (AODV), Ad hoc On-Demand Multi Path Distance Vector (AOMDV), Destination-Sequenced Distance Vector (DSDV) and Dynamic Source Routing (DSR) protocols. Simulation results illustrate the efficiency of the proposed system with packet delivery rates of up to 60 percent at shore base stations.

II. LITERATURE SURVEY

Title of the paper	Author name	Aiming for
Design and Implementation of an IoT based Monitoring System for Inland Vessels using MultipleSensors Network	Muhammad Irfanul Haque Soumic ShekharAoyon	This system proved successful whilst testing. With the use of multi sensor networks transferring multiple data to a central hub which is then organized and displayed using a web application.
Smart ship	Chaitra H.V ,Ashika H.R , Kavhita K.S	This paper has shown the successful demonstration of Smart Ship project by using smart technologies such as sensors, cloud and mobile applications.
Design and development of underwater IOT node and floating gateway		The purpose of this paper is to develop a underwater wireless communication system with better data rates and in an easy manner by developing an IoT node and a floating gateway

Table 2.1 literature survey

III. METHODOLOGY

A cartography application is proposed where the SANET is used to collect different marine sensory data from ships and vessels and send this data back to onshore sinks collocated with 5G base Station's that include dedicated storage as part of the mobile edge computing (MEG) services. Mobile edge computing usually relates to mobile network applications and data stream acceleration through caching and/or compressing of relevant (mainly localized) data at the edge of the mobile network, as near as possible to the end user location. In this method new application of MEC where part of the edge computing resources is exploited as edge repositories (clouds) of collected sensory data that successfully arrives to shore. The edge clouds eventually connect to a central cloud in the internet where all the sensory data is aggregated, filtered and analyzed to produce real-time maps of surface and under water environmental information that produces accumulative maps for beneficiary customers. The proposed IOT-enabled system used for marine data acquisition and cartography. It can be used to collect data, including but not limited to: sea state, depth, temperature, wind speed/direction, humidity, salinity, etc. An identified obstacle is the bottleneck of traffic near the onshore sink. A quantization and compression method specific to marine sensory data has been proposed in our previous work and partially alleviates this problem. For each of the sensors mentioned previously we have set the extreme lower and upper limits of the sensors readings likely to be found in the marine environment as well as the level of accuracy required to represent each reading. The predictability of gathered sensor data makes it beneficial to quantize the data to reduce the amount of bits needed to represent each reading in the binary representation. Applying this quantization in conjunction with the compression algorithm (AMDC) proposed in has given effective data compression rates in comparison to the maincompression methods.

IV. SYSTEM DESIGN

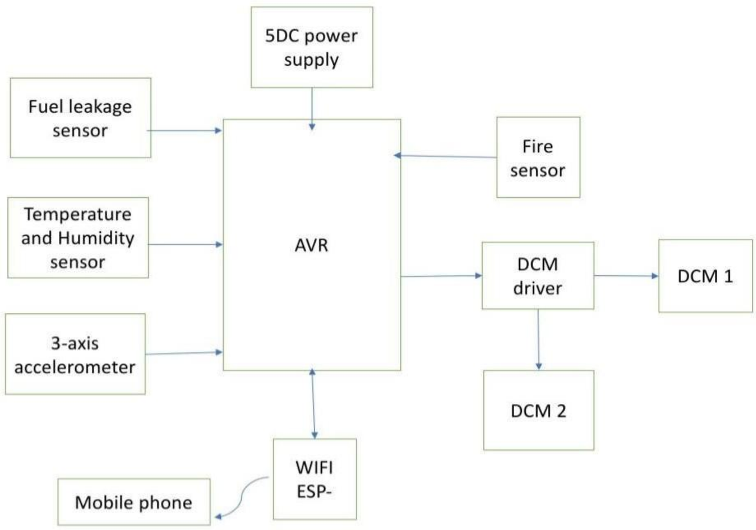


Figure 1: Block Diagram of proposed system

The AVR32 is a 32-bit RISC microcontroller architecture produced by Atmel. The microcontroller architecture was designed by a handful of people. The multiply–accumulate unit can perform a 32-bit × 16-bit + 48-bit arithmetic operation in two cycles (result latency), issued once per cycle.

The Wi-Fi module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume. The Fire sensor, as the name suggests, is used as a simple and compact device for protection against fire. The module makes use of IR sensor and comparator to detect fire up to a range of 1 -2 meters depending on fire density. Fuel leakage sensing cable detects the presence of liquid hydrocarbon fuels at any point along its length, yet it does not react to the presence of water. Installed with a TraceTek Sensor Interface Module and TraceTek Alarm Panel, the cable senses the hydrocarbon liquid, triggers an alarm and pinpoints the location of the leak within one meter. The cable is designed to be attached to the bottom of horizontal piping, spiraled around vertical pipe, or placed on flat surfaces below or around pumps and valves and other applications where surface level fuel leaks and spills can be anticipated.3-axis acceleration measurement system. The accelerometer has a measurement range of ±3 g mini- mum. It contains a polysilicon surface-micro machined sensor and signal conditioning circuitry to implement an open-loop acceleration measurement architecture. The output signals are analog voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.L80 GPS module with an embedded patch antenna (15mmx15mmx4mm) and LNA brings high performance of MTK positioning engine to the industrial applications. It is able to achieve the industry's highest level of sensitivity, accuracy and TTFF with the lowest power consumption in a small-footprint lead-free package.

V. BACKGROUND WORK

5.1 hardware detail

I. AVR Microcontroller

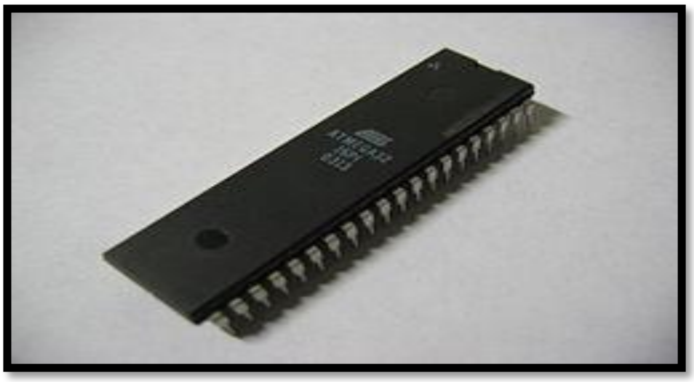


Figure 2: AVR Microcontroller

The AVR32 is a 32-bitRISC microcontroller architecture produced by Atmel. The microcontroller architecture was designed by a handful of people. The multiply–accumulate unit can perform a 32-bit × 16-bit + 48-bit arithmetic operation in two cycles (result latency), issued once per cycle. It does not resemble the 8-bit AVR, even though they were both designed at Atmel Norway, in Trondheim. Some of the debug-tools are similar.

II. fire sensor

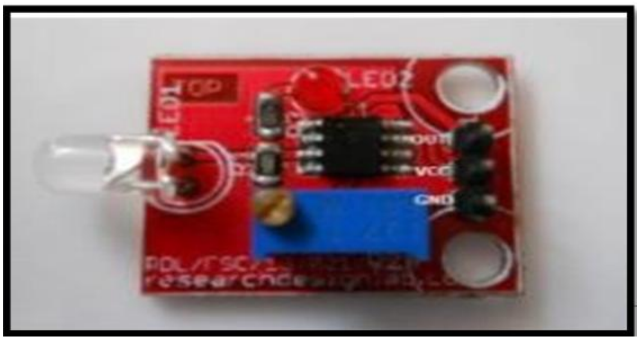


Figure 3: fire sensor

The Fire sensor, as the name suggests, is used as a simple and compact device for protection against fire. The module makes use of IR sensor and comparator to detect fire up to a range of 1 -2 meters depending on fire density.

III. fuel leakage sensor

Leak detection systems work by monitoring water flow through either a mechanical turbine or ultrasonic wavelengths. These leak detection systems observe the pattern of the water flow, either by counting the gallonage passing through the sensor or sonically recording the time delay.

IV. WIFI Module

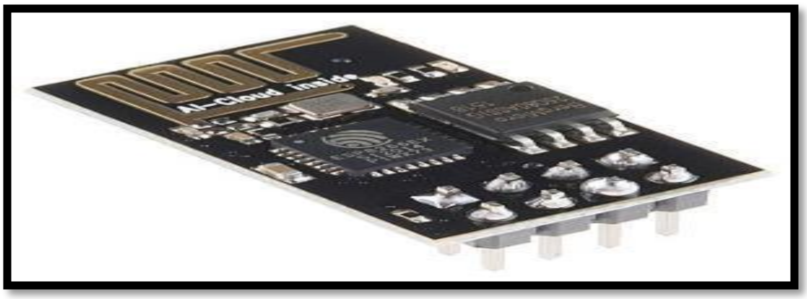


Figure4: WIFI Module

ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Shanghai-based Chinese manufacturer, Es press if Systems.The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands.

V. GPS Module

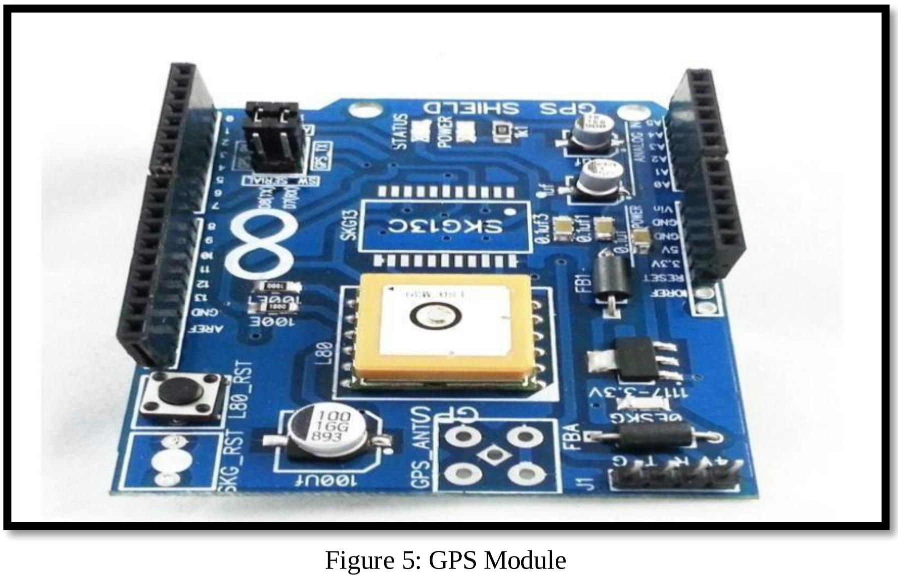


Figure 5: GPS Module

This L80 GPS module. It describes L80 module hardware interfaces and its external application reference circuits, mechanical size and air interface. L80 GPS module with an embedded patch antenna (15mmx15mmx4mm) and

LNA brings high performance of MTK positioning engine to the industrial applications. It is able to achieve the industry's highest level of sensitivity, accuracy and TTFF with the lowest power consumption in a small-footprint lead-free package.

VI. 3 axis accelerometer

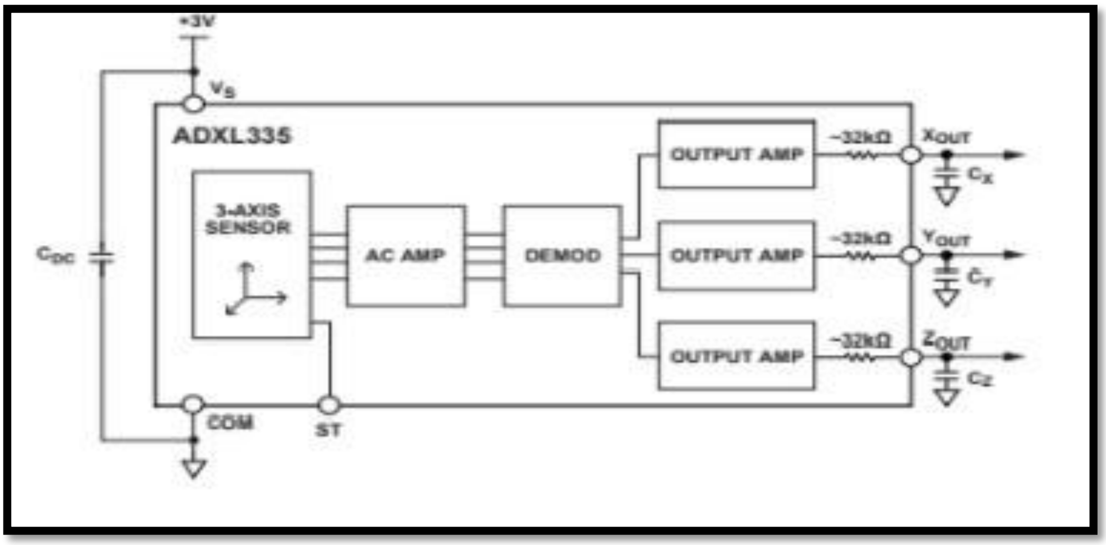


Figure 6 : 3-axis accelerometer

An accelerometer is a device that measures proper acceleration.[1] Proper acceleration, being the acceleration (or rate of change of velocity) of a body in its own instantaneous rest frame,[2] is not the same as coordinate acceleration, being the acceleration in a fixed coordinate system. For example, an accelerometer at rest on the surface of the Earth will measure an acceleration due to Earth's gravity, straight upwards (by definition) of g ≈ 9.81 m/s2. By contrast, accelerometers in free fall (falling toward the center of the Earth at a rate of about 9.81 m/s2) will measure zero.

VII. Dc motor drive circuit

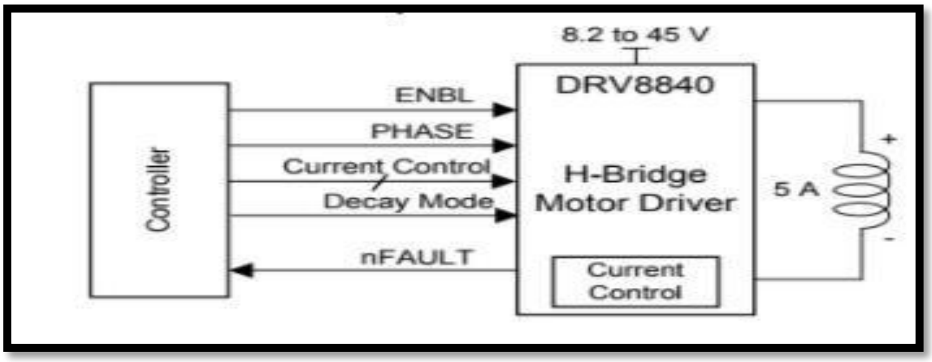
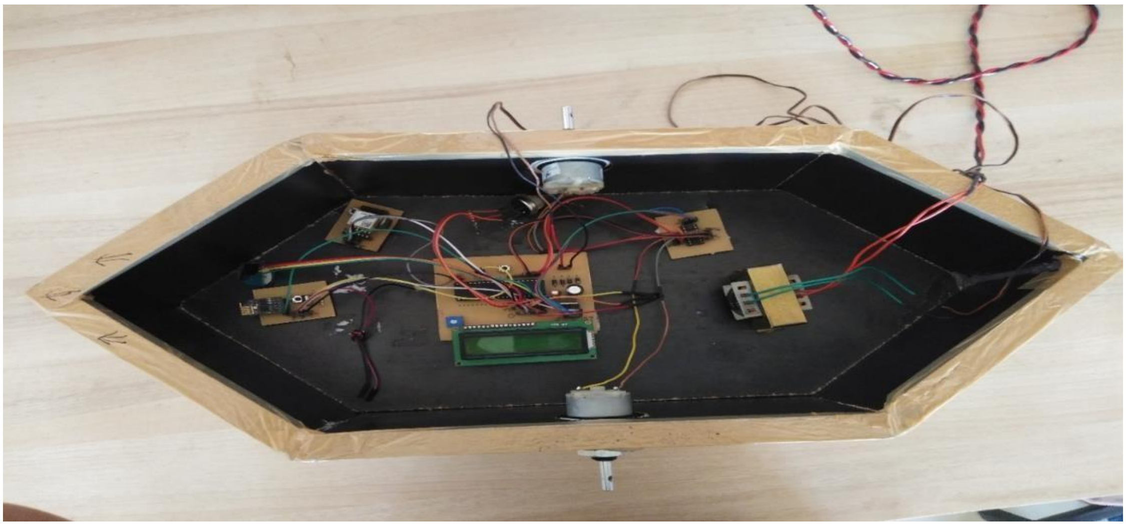
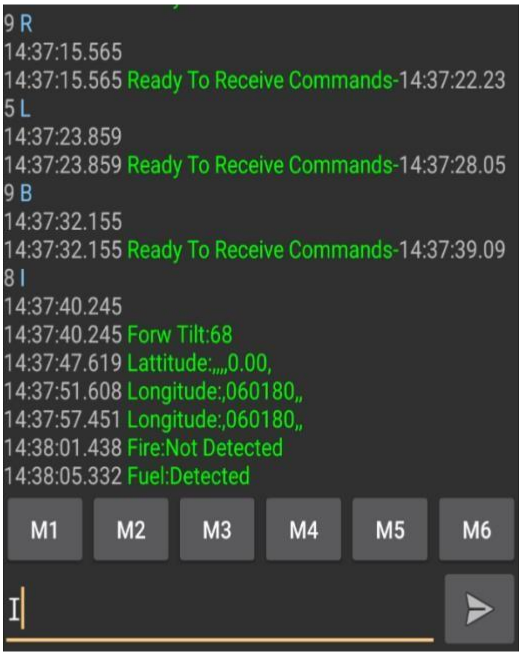


Figure 7: Dc motor drive circuit

The DRV8840 provides an integrated motor driver solution for printers, scanners, and other automated equipment applications. The device has one H-bridge and is intended to drive one DC motor. The output driver block for each consists of N-channel power MOSFETs configured as full H-bridges to drive the motor windings. The DRV8840 can supply up to 5-A peak or 3.5-A output current (with proper heat sinking at 24 V and 25°C).

VI. RESULT




9 R
14:37:15.565
14:37:15.565 Ready To Receive Commands-14:37:22.23
5 L
14:37:23.859
14:37:23.859 Ready To Receive Commands-14:37:28.05
9 B
14:37:32.155
14:37:32.155 Ready To Receive Commands-14:37:39.09
8 I
14:37:40.245
14:37:40.245 Forw Tilt:68
14:37:47.619 Lattitude:,,,,0.00,
14:37:51.608 Longitude:,060180,,
14:37:57.451 Longitude:,060180,,
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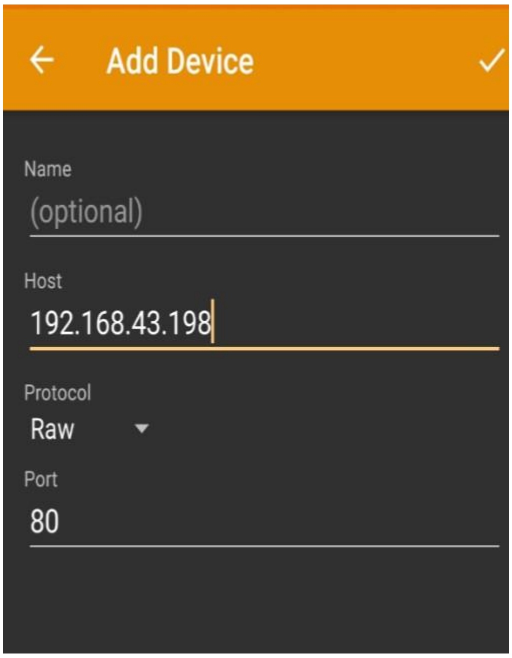
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Raw
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80

VII. CONCLUSION

Due to increased shipping and the high cost of other available technologies, the demand for data networks in the marine environment for safety and convenience shows an increasing trend. In this project implementing IoT data networks in a marine environment has been shown using the existing Wi-Fi communication infrastructure available on all ships.

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