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Development of Embedded Tether Interface Modem

Sagma N. G., Dr. G. R. Gnana King

Elecronics and Communication Engineering Department, Sahrdaya College of Engineering and Technology, Thrissur India

Associate Professor, Elecronics and Communication Engineering Department, Sahrdaya College of Engineering and Technology, Thrissur India

ABSTRACT

This paper proposes a wired system for observing submerged pipeline infrastructure. This paper uses a wired tether which is used for the communication between client and server. Raspberry Pi and remote PC both are part of client-server architecture and that is communicated over TCP\IP protocol, also Raspberry Pi communicates with PixHawk over a serial connection. Fathom-X tether allows the use of Ethernet and power over 2 wires and distances up to 300 meters. In this system, we are using a pair of Fathom-x boards for sending information and power back and forth on the PixHawk. This wired network connected to sensor devices that measure specific parameters such as underwater pressure and temperature. Global Positioning System (GPS) also connected to PixHawk to send sensed information from underwater to the topside computer far from the pipeline. A low-light HD USB camera attached to Raspberry pi, which receives control data from raspberry pi and sends pictures and recordings to the remote PC, and they are generally used for underwater surveillance. The wired arrangements give high information rate and exact arrangements particularly for submerged pipeline checking, wired system also provide higher communication bandwidth. On a test with two wire tethers, the data test comes with 81.2 Mbps rate.

Keywords: Fathom-X tether, IP network, Pipeline monitoring, PixHawk, Sensor systems, TCP/IP, Wired network.

1. INTRODUCTION

This paper proposes a wired architecture for monitoring underwater pipeline infrastructure. The wired system associated with sensor gadgets that measure explicit boundaries, for example, pressure and temperature. In this system tether wires are used for two-way communication. The wired arrangements give high information rate and exact arrangements particularly for submerged pipeline checking, wired system also provide higher communication bandwidth. Mainly underwater pipelines are used for transportation of gas, water, and oil and they have become essential part of most countries. Frequent monitoring of the infrastructure of underwater pipeline are necessary. Most of the large pipelines are located in underwater. Assaults to such pipelines, just as gear disappointment can prompt massive ecological effect and loss of pay, nowadays lots of technologies like computational pipeline monitoring systems are used for observing and controlling submerged pipelines. These types of advancements using sensory elements to monitor surrounding conditions of pipelines and transfer sensed data collected from underwater pipelines to the central location.

Likewise, there are some wired sensor organize used to screen the territory around the pipelines to find any ill-conceived activities. The sensors necessary for good underwater monitoring are pressure and temperature sensors. This project overcome the disadvantages of traditional cat5 and cat6 ethernet cables like interference, crosstalk etc. Here we proposed to use a wired tether, which is used for the communication between client and server. Raspberry Pi and remote PC both are part of a client server architecture and that are communicates over TCP\IP protocol. Fathom-X tether interface boards are based on HomePlug AV standard for sending power and information over two wires and distances more than 100 meters. The Fathom-X tether can extend the range significantly and it makes the tether easier.

2. RELATED WORKS

In [1], a couple of optical modems has been utilized, which used to transmit Ethernet signals through water. The outcomes show that this optical remote modem give a solid 10Base-T IEEE standard bi-directional transmission information a good way off up to 10 m in shallow harbor water and sunlight condition. In [2] one of the reasonable Ethernet systems is explored, which is practical and broadly sent for executing organized control frameworks. A client- server control configuration is made based on ethernet. The created framework is executed on a modern fish-preparing machine. In [3] examines the issues and difficulties in the utilization of new and extremely encouraging innovation in the assurance and checking of the basic and basic foundations of pipelines conveying oil, gas, water, and

other significant assets. This framework utilizing copper or fiber optic links for wired association. This framework utilizes sensors to quantify specific boundaries, for example, flow rate, pressure, temperature, and so forth.

In [4] proposes another deficiency lenient wired sensor organize engineering for observing submerged pipeline foundations. This framework utilizes both wired and remote system. This framework illuminates the current real issues related with wired systems for pipelines foundation checking. In [5] tentatively confirms the reasonableness of different client-server design dependent on neighborhood can be utilized as a continuous correspondence standard for potential applications in industrial facility computerization, the experiment shows that MC-MS architecture remained stable at more than 75%, and packet loss was very less.

3. METHODOLOGY

In this framework we proposed to utilize tether wire to connect with the Raspberry Pi. There is an information transmission between remote PC and Raspberry Pi. There is a data transmission between remote PC and Raspberry Pi. Both are part of a client- server architecture and that are communicates over TCP\IP protocol. Here we are utilizing two Fathom-X's tether wires to transmit information and power to and from on the PixHawk. Fathom-X allows use of data transmission over 2 wire and distances up to 300 meters. The Fathom-X works by using same wires that carry power to transmit data. Use a cat5 cable to connect the Fathom-X to the PC's ethernet port.

PixHawk communicating with Raspberry Pi via MAVLink protocol over a serial connection, for that one of the serial ports of PixHawk connected to the Raspberry Pi's +5V, Ground, Tx, Rx pins. To begin with, we need to arrangement the Raspberry Pi and interfacing the Raspberry Pi with a SSH, for example, putty. Then we have to install required packages on the Raspberry Pi. The PixHawk will react to MAVLink messages got from Raspberry Pi through serial port. To quantify explicit boundaries, for example, submerged pressure and temperature here we are utilizing pressure sensor and temperature sensor and that are connected on the PixHawk. Both are associated with the i2c port of the PixHawk. GPS additionally associated with PixHawk to move detected information from submerged to the remote PC far away from pipeline. A low light HD USB camera attached to Raspberry Pi used for underwater video surveillance.

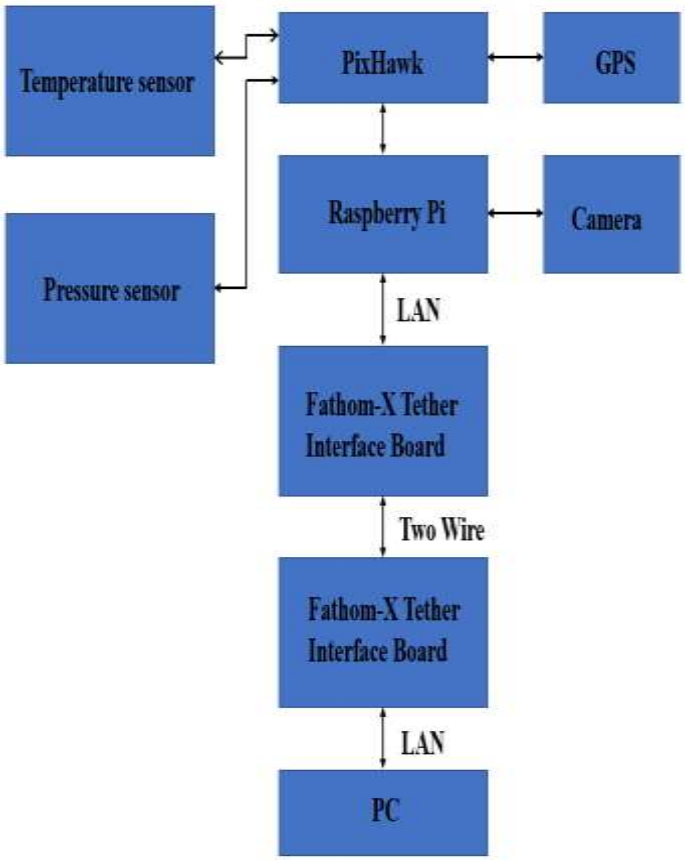

Fig. 1. Block diagram of proposed work

3.1 Fathom-X Tether Interface

Fathom-X tether is to transmit information and power to and from on the PixHawk. Thus, the pairs used for normal ethernet communications are the green and orange pairs. The Fathom-X use a single pair of wire and also it can extend the range significantly. Powered Fathom-X boards with 60Watt 12V DC power source. The Fathom-X will work on a single twisted pair of wires, the twist eliminates noise induced from outside electromagnetic signals. Connection between two Fathom-X tether interface boards are like, connect wire to tether input '+' and other to tether input '–'. Connect the other end of the tether wires to the topside Fathom-X tether input. Which means the tether input wires should connect '+' to '+' and '-' to '-'. There is a fullduplex communication over a single twisted pair of wires and data transmission is synchronous, at the same time transmitting one bit after another with no start or stop bits and no gaps.

4. EXPERIMENTAL RESULTS

The results are taken on the study of underwater pipeline infrastructure. This mainly used for monitoring and controlling underwater pipeline infrastructure. Experiments verifies that two wire tethers are efficient for monitoring underwater pipelines.

4.1 Stage- 1 Results

In this stage an open source programming called Ardusub introduced on a PixHawk, besides it runs in a companion PC called Raspberry Pi. MAVLink protocol is used for the serial communication between PixHawk and Raspberry Pi. Connected

the Pixhawk's one of the serial ports to the Raspberry Pi's +5V, Ground, TX and RX pins. Sign into the Raspberry Pi board (default username and secret key is pi and raspberry) and watch that its association with the web is working, After the web association is affirmed to be working introduce the necessary packages on the Raspberry Pi. The Pixhawk will react to MAVLink messages got from Raspberry Pi through serial port. Continue with the instructions in the mission planner for setting up the software and configuring network settings. Raspberry Pi is assigned a static IP address of 10.0.0.100 and it expects the remote PC to have an IP address of 10.0.0.102. The network configuration on the remote PC needs to be set up before it communicates with the PixHawk.

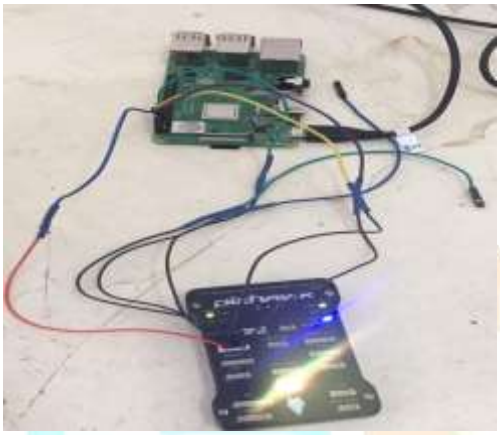

Fig. 2. Connecting PixHawk with Raspberry Pi

Use two Fathom-x tether interface boards for transmitting information and power to and from on the PixHawk. Thus, the wired system associated with sensor gadgets that measure explicit boundaries, for example, submerged pressure and temperature. Both sensors are associated with the PixHawk. A low-light HD USB camera attached to Raspberry pi, which receives control data from raspberry pi and sends pictures and recordings to the remote PC, and they are commonly used for underwater surveillance. Video from a Low-Light HD USB camera, with a pixel size of 1920X1080 is transmitted to the remote PC with 40fps frame rate.

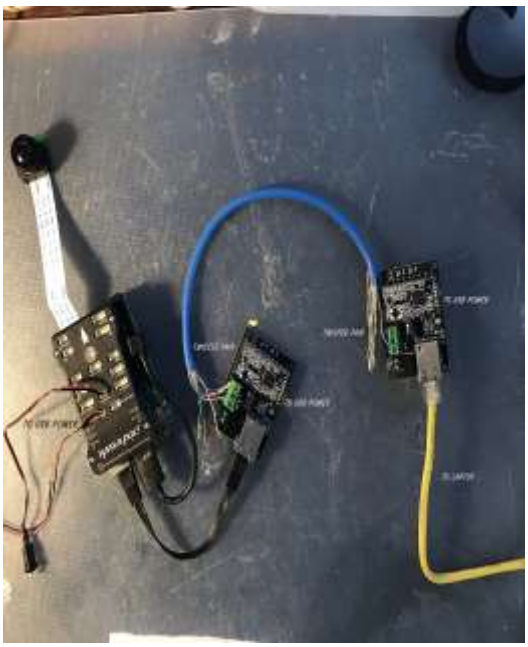

Fig. 3. Interfacing sensors and camera and Fathom- X tether interface boards are connected using tether wires

4.2 Stage- 2 Results

In this stage data transmission rate between client and server was measured using an open source tool called iperf. Raspberry Pi is connected to remote PC using Fathom-X tether interface through more than 100 meters of wire giving correspondence a data transmission of 81Mbps. 12V DC power can be also transferred through these tether wires.

From the below figures Fig. 4. and Fig. 5. We can see the available network bandwidth. To measure available network bandwidth first download the iperf tool on both Raspberry pi and PC.

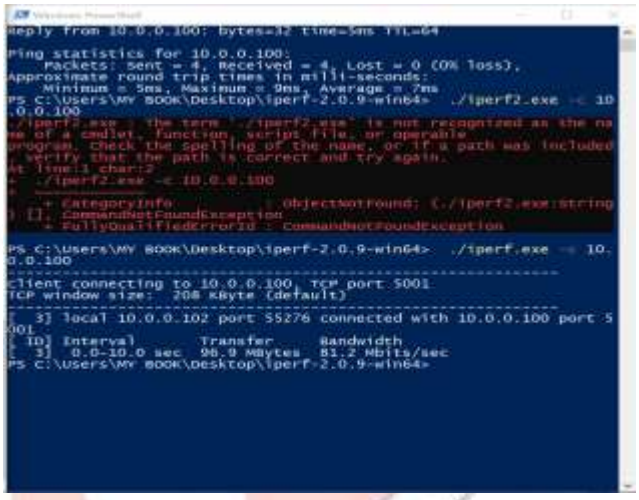

Fig. 4. PC as Client

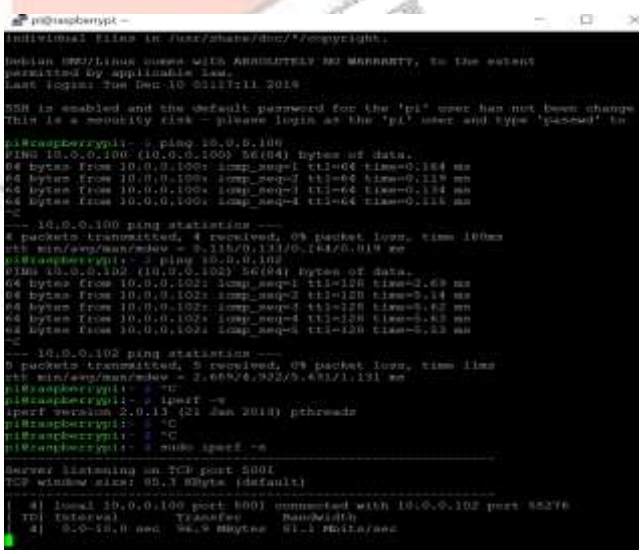

Fig. 5. Raspberry Pi as Server

The -s command is used to start the server on the Raspberry Pi. By default, it listening on the TCP port 5001 and its TCP window size is 208 KB. The -c command is used to start the client on the PC and it is connected to TCP port 5001. To measure bandwidth from client machine PC transfer 96.9 MB data to the Raspberry Pi. Output shows that I got a speed of 81 Mbits/sec. The data transfer occurs within an interval of 10 seconds.

5. CONCLUSION

Submerged pipeline systems have become a basic piece of life. Henceforth consistent dynamic checking and controlling framework is required to keep up the strength of the submerged pipelines. This wired system framework gives better unwavering quality to pipeline checking frameworks as far as system network, maintainability, and congruity of power supply. So that, this system using wired network for observing submerged pipeline infrastructure. Information transmission between Raspberry Pi and remote PC using Fathom-X tether interface through more than 100 meters of wire giving correspondence a data transmission of 81Mbps. The Fathom-X works by utilizing same two tether input wires that convey power to transmit information. Video from a Low-Light HD USB camera, with a pixel size of 1920X1080 is transmitted to the remote PC with 40 fps frame rate. Comparing with wireless technologies wired arrangements give high information rates, ideal, solid and precise arrangements, particularly for the long profundity submerged pipeline checking.

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Sagma N G received Bachelor of Technology in Electronics and Communication Engineering from University of Calicut, Kerala, India in 2017. She currently doing her Master of Technology in Embedded Systems at Sahrdaya College of Engineering and Technology, Kerala Technological University, Kerala, India. Her research interest includes Multimedia security, Deep learning and Image processing.
Email: sagmanaduvil@gmail.com

Dr. G. R. Gnana King received BE in Electronics and Communication Engineering from ANNA University, India in 2007, ME in Applied Electronics from Anna University, India 2009 and PhD degree in Electronics and Communication Engineering from Anna University, India 2016. He is working as Associate professor in the department of Electronics and Communication Engineering at Sahrdaya College of Engineering and Technology, Kerala. He has 10 years of teaching experience. He has published 39 papers. His areas of research include Medical Image Processing. He is a life member of Indian Society for Technical Education, New Delhi and member of Society of Digital Information and Wireless Communications (SDIWC).
Email: gnanaking@sahrdaya.ac.in