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Gelam Wood Design as a Water Level Measurement Sensor to Support Green Electronics Realization

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Abstract: The water level of peat land in the South Sumatra area required to be monitored for mitigating the wildfire or flooding annual risk happends in the region. The Gelam wood is easily found in the peat land thus the utilization as a water level sensor should be a perfect solution. Therefore, we designed a Gelam wood sensor as the sensing element, a voltage divider circuit as a transducer and a modem connected to a website to display the data for the user. The accuracy of the sensor is 98% with a resolution of about 1 cm in height. The system design was implemented to monitor the water level height of a campus lake and compared the output with a calibrated ultrasonic sensor. The reading error between both sensors was about 1.9%. Therefore, the use of Gelam wood as a water level measurement sensor can be developed towards the realization of 'green electronics' to obtain energy efficiency in producing an electronic component; eco-friendly and non-toxic materials thus it can reduce the electronic waste accumulated every year.

Keywords: Gelam wood; Green electronics; Ultrasonic sensor; Water level monitoring

Introduction

Green electronics represent a crucial advancement in technology, utilizing flexible, renewable, organic, and biodegradable materials that advocate for sustainability and environmental preservation. Not only enhancing energy efficiency; it also addresses the critical issue of electronic waste. Electronic waste that cannot decompose is piling up each year. The alarming volume of electronic waste produced daily poses a grave threat not only to our planet but also to human health. Consequently, the urgent development of green electronics made from abundant, eco-friendly, non-toxic materials is one of the most pressing challenges we face today (Danish et al., 2019; Irimia-Vladu, 2014; Li et al., 2020; Misra et al., 2021; Piro et al., 2020; Roselli et al., 2015; Su et al., 2022; Takehara et al., 2020; Tao et al., 2017). Therefore, using materials like wood for manufacturing electronic components, for instance, could be an effective and smart solution (H. Zhu et al., 2016).

There have been many discussions on naturally derived organic materials for various applications. In 2012, Trey et al obtained a semi-conducting material by using wood as the base template (Trey et al., 2012). In 2015, Lv et al. (2015) fabricated a wood-based supercapacitor that utilized a simple dipping and polymerization mechanism. Several research groups manufactured wood as conductive materials as reported in (Guo et al., 2018; Hou et al., 2015; Kim et al., 2019; Łukawski et al., 2019; Wan et al., 2017; X. Zhu et al., 2015) while other teams developed electronic circuits on wood-derived substrate (Egger et al., 2024; Fu et al., 2020; Sun et al., 2021). In 2025, Zhu et al. published a wood-derived carbon electrode to realize a supercapacitor (X. Zhu et al., 2025). Wood-based panels can also be modified with carbon black and carbon fibers to perform moisture, temperature and pressure detection (Kocoglu et al., 2024). Pine and Spruce woods were employed as moisture sensors by Konopka et al. (2018) and Mulla et al. (2023), respectively, by observing the electrical resistance changes of the Pine and coating

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the Spruce with lignin ink. The natural wood processed as a pressure sensor also had been reported in Guan et al. (2020), Huang et al. (2021), and Luo et al. (2023) based on piezoresistive-piezoelectric coupling effects in the porous wood. In 2022, Ram et al. (2022) developed wood veneers as vibration sensors while (Dreimol et al., 2022) utilized laser-induced-graphitization on wood to produce strain sensors. A real-time wireless food-quality monitoring had been designed by integrating a porous wood-based triboelectric nanogenerator and gas sensor as reported in (C. Cai et al., 2021). Cai et al. demonstrated a wood sponge sensor to detect and adsorb heavy metal ions in 2022. Back then in 1996, wood was used to measure humidity as a function of the wood's electrical resistance and of its temperature (Y. Cai et al., 2022). To the best of our knowledge, no publication wrote about wood's resistance characteristics as a water level measurement sensor. There is only used wooden substrates for liquid-level detection based on capacitive sensors using laser-induced graphene (Carll et al., 1996).

Tracking water levels is an essential task for a variety of purposes, such as maintaining product quality in industrial processes (Santhosh et al., 2020), optimizing rice yields in agricultural fields (Maneekul et al., 2017; Morchid et al., 2024; Saptomo et al., 2023; Xiao et al., 2013), reducing flood hazards in urban areas near rivers (Machefer et al., 2022; Mousa et al., 2016; Susanti et al., 2024; Yunita et al., 2020), and controlling water distribution systems within communities (Bathre et al., 2022; Loizou et al., 2016; Shi et al., 2021; Singh et al., 2021). Conventional monitoring techniques tend to be inefficient and costly because they depend on manual data collection, which necessitates taking measurements at specific times and locations. To overcome these challenges, water level monitoring should incorporate telemetry systems, which can alleviate the difficulties linked to manual measurement methods (Idris et al., 2016; Jones, 2024; Panyadee et al., 2024).

The instruments used for measuring water levels can be categorized into various types: hydrostatic pressure sensors, radar level meters, optical fiber sensors, laser measurement devices, capacitive sensors, and ultrasonic sensors (Mohindru, 2023). Among these, ultrasonic sensors are the most widely used due to their high precision. Generally, these sensors are operated by microprocessors that collect data and store it in digital memory. In 2018, Natividad et al. (2018) created a flood risk early warning system utilizing ultrasonic sensor technology and an Arduino linked to a GSM module, which sent alerts to residents in the Philippines through SMS. The Diriyana group in 2019 merged ultrasonic sensor with the NodeMCU-Esp8266 to develop an early flood warning system that operated via the Telegram app (Diriyana et al., 2019). Additionally, a Brazilian research team in 2022 set up five ultrasonic sensors in a chamber with flowing channels to test the accuracy of the sensors in turbulent water, though their study did not include any data transmission methods (Pereira et al., 2022).

This work proposed a wood-derived sensor for water level monitoring in a campus lake based on its resistance. The performance was compared with a standardized ultrasonic sensor. The type of wood used in the research is Gelam Wood or known as Melaleuca Cajaputi, that is resistant to acidic environments and waterlogging. It is widely found and utilized in South Sumatra, especially in peat swamp areas, which has a relatively fast growth rate of 1-1.5 cm per year. As is widely known, South Sumatra faces significant annual risks from natural disasters like flooding and wildfires, primarily due to its extensive peatland, which covers 1,262,000 hectares (Lestari et al., 2021). By effectively monitoring water levels in these peatlands as well as in lakes and other inland water bodies, officials can receive alerts when water levels surpass safe maximum limits, helping to prevent flooding, or drop below safe minimum levels, which can help avert wildfires. It is widely acknowledged that dry conditions heighten fire risks, making minimum water depth a vital metric for assessing potential threats (Taufik et al., 2012).

Method

Figure 1 is the research flow of this work. The hardware and software for embedded program were designed before conducting the sensor calibration. In the laboratory experiment, Gelam wood with a homogeneous diameter of 1.5 m was placed in a white drum that swas slowly filled with water using a hose. A ruler was installed as a reference for the height of the water surface in the drum. In addition, a calibrated ultrasonic sensor was also placed side by side with the Gelam wood as a comparison tool (Figure 2).

Figure 1. Research flow

Two conductor wires were tied to the wood using thin cables so that they attached to the bark from the base to the end of the wood as far as 1 m with a distance between the wires of 2 cm (Figure 3). The first wire was connected to Vcc +5 Volt while the second wire was used as input for the analog input of the NodeMCU ESP8266.

Figure 2. Gelam wood sensor calibration procedure

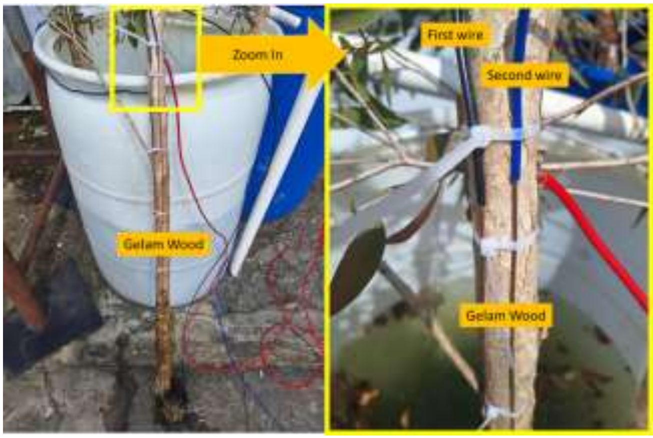

Figure 3. Gelam wood sensor design

Figure 4 shows the modem box that regulates the sending of data from the water surface height measurement results by the Gelam wood sensor and ultrasonic sensor to the website monitored by the user. A potentiometer with a size of 10 kOhm was installed on the modem to form a voltage divider circuit with the resistance value obtained from the Gelam wood. The resistance value of the wood will change following changes in the height of the water surface. By adjusting the resistance value of the potentiometer, the sensor output value will be obtained which is proportional to the value of the water surface height level. These values are linear with increasing height so that a linear equation will be obtained for the calibration process. A Wi-Fi modem is used to send sensor data controlled by NodeMCU ESP8266 using radio waves to the user. When the system successfully measures the water level, the modem and Gelam wood sensor are applied in the Campus Lake for testing and field implementation. Formula (1) is a common voltage divider formula for a two resistor voltage divider circuit.

$$V_{out} = \frac{V_{in} \times R_2}{(R_1 + R_2)} \quad (1)$$

where in this case, V_{in} = 5 Volt, R_1 is the wood resistance, R_2 is the potentiometer value and V_{out} is the sensor data that process by NodeMCU board. R_2 must be set equal with R_1 to obtain a good sensor reading.

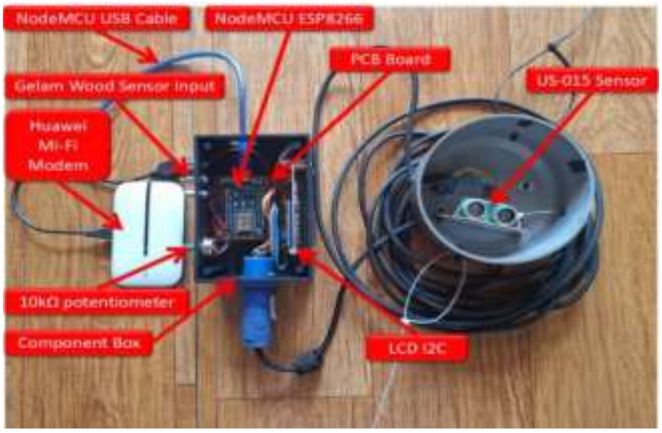

Figure 4. Gelam wood and ultrasonic sensors as NodeMCU ESP8266 input to control the water level measurement data

Result and Discussion

Sensor Calibration

The initial stage of testing the Gelam wood sensor was carried out on a laboratory scale to ensure that the sensor was calibrated by comparing the sensor readings with reference measuring instruments such as rulers and standard ultrasonic sensors. Measurements of the water surface level were repeated ten times to calculate the standard deviation and error of the sensor readings from the results shown by the comparison instrument. The results are as can be seen in Table 1 and Figure 5. The error of the calibration data is below 2%. The curve in the figure shows the average value of 10 repetitions for each water level that fills the white drum. It appears that the curve line is linear with the R2 value = 0.99, thus proving that the Gelam wood sensor was calibrated with acceptable range of errors.

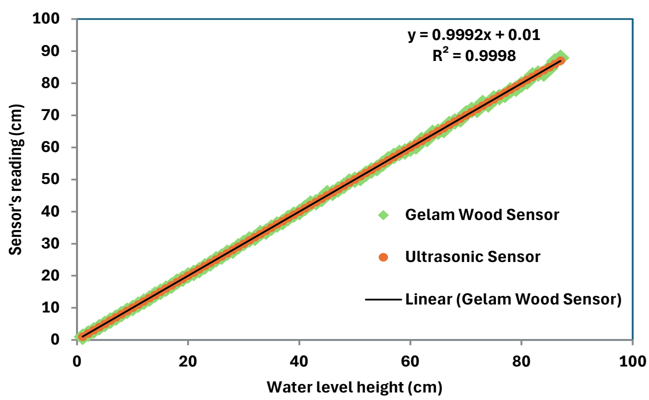

Figure 5. Gelam wood sensor calibration curve

Table 1. Calibration Data of Gelam Wood Sensor (10 Times Measurement) Compare with Sensor US-015

Water Level Height											Average (cm)	Bias	SD (σ)	Precision (%)	Accuracy (%)	Error (%)
US-015 (cm)	Gelam (cm)															
	1	2	3	4	5	6	7	8	9	10						
1	1.00	0.99	1.01	0.99	1.01	1.00	0.99	1.01	0.99	1.00	1.00	0.00	0.01	99.12	99.90	0.10
2	2.02	2.02	2.04	2.00	2.00	2.03	2.01	2.01	2.03	2.01	2.02	0.02	0.01	99.34	99.15	0.85
3	2.97	3.00	3.01	2.96	2.99	2.95	2.97	2.95	2.99	2.96	2.98	-0.02	0.02	99.29	99.17	0.83
4	3.98	3.97	3.97	3.98	3.98	3.94	4.02	3.97	4.02	3.96	3.98	-0.02	0.02	99.38	99.48	0.52
5	4.96	4.99	4.90	4.98	5.00	4.99	4.93	4.94	5.00	4.98	4.97	-0.03	0.03	99.32	99.34	0.66
6	5.97	5.92	6.01	6.02	6.04	6.05	6.00	5.96	5.87	5.93	5.98	-0.02	0.06	99.03	99.62	0.38
7	6.83	6.97	6.99	6.97	6.99	6.99	7.09	6.96	6.99	6.98	6.98	-0.02	0.06	99.10	99.66	0.34
8	8.07	8.03	8.07	8.14	8.05	8.01	7.94	8.07	7.91	8.15	8.04	0.04	0.08	99.05	99.45	0.55
9	8.98	9.15	9.12	9.08	8.99	9.11	8.98	9.19	9.09	9.05	9.07	0.07	0.07	99.19	99.18	0.82
10	10.13	9.99	9.96	10.03	9.83	10.09	10.01	9.98	10.00	9.88	9.99	-0.01	0.09	99.11	99.90	0.10
11	10.93	10.86	11.19	10.82	11.08	11.09	10.89	11.04	10.93	10.85	10.97	-0.03	0.12	98.87	99.71	0.29
12	12.00	11.75	11.95	11.91	11.81	11.92	12.05	11.93	12.04	11.94	11.93	-0.07	0.09	99.21	99.42	0.58
13	13.15	12.78	12.82	13.12	12.85	12.84	12.90	12.76	12.94	13.03	12.92	-0.08	0.14	98.93	99.38	0.62
14	14.27	14.31	14.09	13.99	14.04	14.27	13.94	14.01	13.99	14.17	14.11	0.11	0.14	99.03	99.23	0.77
15	15.04	15.04	14.89	15.02	14.95	14.61	14.92	15.16	15.24	14.94	14.98	-0.02	0.17	98.87	99.87	0.13
16	16.16	16.01	15.90	15.76	16.01	15.91	16.15	15.77	15.97	15.85	15.95	-0.05	0.14	99.13	99.68	0.32
17	16.92	17.19	16.75	16.77	16.96	17.20	16.74	16.85	16.83	16.63	16.88	-0.12	0.19	98.88	99.32	0.68
18	18.22	18.27	18.24	18.31	18.27	18.15	17.83	18.53	17.92	18.29	18.20	0.20	0.20	98.90	98.87	1.13
19	19.15	19.26	18.96	19.10	19.00	18.96	19.08	19.05	18.94	19.42	19.09	0.09	0.15	99.20	99.52	0.48
20	20.02	20.34	19.94	20.32	20.63	19.98	20.17	19.77	19.70	19.88	20.08	0.07	0.29	98.56	99.63	0.37
21	21.13	20.52	20.51	21.11	20.81	21.11	20.82	20.95	20.75	20.77	20.85	-0.15	0.23	98.91	99.28	0.72
22	21.80	22.04	21.45	22.08	21.40	21.62	21.72	22.05	22.11	21.45	21.77	-0.23	0.28	98.69	98.96	1.04
23	22.68	22.90	22.75	22.98	22.84	23.22	23.02	22.97	22.94	23.00	22.93	-0.07	0.15	99.34	99.70	0.30
24	23.87	23.87	24.00	23.66	23.79	23.96	23.79	23.91	23.76	23.87	23.85	-0.15	0.10	99.58	99.37	0.63
25	25.14	25.23	25.21	25.17	25.24	24.99	25.15	25.02	24.94	24.92	25.10	0.10	0.12	99.51	99.60	0.40
26	25.80	26.17	25.89	26.41	25.77	25.96	25.58	25.91	25.61	26.25	25.94	-0.07	0.27	98.96	99.75	0.25
27	26.94	27.08	27.36	27.46	27.33	27.07	27.47	26.95	27.05	26.72	27.14	0.14	0.25	99.08	99.47	0.53
28	27.63	27.78	28.12	27.88	28.07	28.12	27.79	27.30	27.50	27.67	27.79	-0.21	0.27	99.02	99.24	0.76
29	29.04	29.51	28.93	29.25	29.61	28.88	29.35	28.72	28.91	29.15	29.14	0.13	0.29	99.00	99.53	0.47
30	30.77	29.50	30.52	30.25	30.59	30.32	30.39	30.05	30.24	29.55	30.22	0.22	0.42	98.62	99.27	0.73
31	31.35	31.17	32.00	30.96	30.88	31.61	31.42	31.04	31.15	31.57	31.32	0.32	0.35	98.90	98.98	1.02
32	32.00	31.57	31.77	31.75	31.96	31.63	31.83	31.98	31.79	32.21	31.85	-0.15	0.19	99.40	99.53	0.47
33	33.37	33.21	33.15	33.42	33.44	33.12	32.92	33.58	33.51	33.23	33.30	0.30	0.20	99.39	99.11	0.89
34	33.31	33.87	34.02	33.55	34.29	33.63	34.04	34.06	33.42	32.97	33.72	-0.28	0.41	98.78	99.16	0.84
35	35.16	34.79	35.04	34.72	35.42	34.65	34.86	34.89	35.22	35.38	35.01	0.01	0.27	99.22	99.96	0.04
36	35.36	35.47	35.97	35.94	36.16	36.53	35.90	36.31	36.64	35.31	35.96	-0.04	0.47	98.70	99.89	0.11
37	36.96	36.66	36.39	36.55	36.74	37.41	36.93	36.59	36.26	36.67	36.72	-0.28	0.32	99.11	99.23	0.77
38	38.16	38.18	38.93	37.88	37.67	37.87	37.99	37.63	38.09	37.75	38.02	0.02	0.38	99.01	99.96	0.04
39	39.14	38.65	38.95	39.69	39.54	39.15	38.83	38.78	38.78	38.82	39.03	0.03	0.35	99.11	99.92	0.08
40	39.63	39.77	39.71	40.20	40.38	40.25	39.27	39.31	40.37	39.79	39.87	-0.13	0.41	98.96	99.67	0.33
41	40.74	40.93	40.98	41.59	40.45	40.88	41.06	41.12	41.69	41.55	41.10	0.10	0.40	99.03	99.76	0.24
42	42.64	42.00	42.67	42.23	42.62	42.17	42.11	41.99	43.01	42.95	42.44	0.44	0.38	99.09	98.95	1.05
43	42.81	43.23	42.71	43.55	42.20	42.25	42.74	43.45	42.41	43.61	42.90	-0.10	0.53	98.76	99.76	0.24
44	44.27	43.88	44.45	44.49	44.05	43.28	43.35	44.06	44.11	43.43	43.94	-0.06	0.44	98.99	99.86	0.14
45	45.72	45.57	46.15	45.22	45.25	45.95	45.27	46.11	45.98	45.68	45.69	0.69	0.36	99.22	98.47	1.53
46	45.73	46.29	45.62	46.29	45.37	45.34	45.88	46.24	45.96	45.41	45.81	-0.19	0.38	99.17	99.59	0.41
47	47.00	46.75	47.97	47.17	45.73	47.16	47.64	46.88	46.48	46.72	46.95	-0.05	0.62	98.69	99.89	0.11
48	47.93	49.05	48.32	48.26	47.08	48.13	48.09	47.39	47.49	48.18	47.99	-0.01	0.56	98.84	99.98	0.02
49	49.74	49.33	48.96	49.34	49.12	49.92	48.69	49.48	48.16	50.65	49.34	0.34	0.69	98.61	99.31	0.69
50	49.98	50.06	49.82	49.94	49.95	49.97	49.95	49.95	49.93	49.95	49.95	-0.05	0.06	99.88	99.90	0.10
51	50.78	50.65	49.57	50.43	49.77	50.84	50.73	50.68	50.23	50.50	50.42	-0.58	0.44	99.14	98.86	1.14
52	52.29	51.99	51.68	51.96	51.60	51.12	51.30	52.22	51.05	52.21	51.74	-0.26	0.46	99.10	99.50	0.50
53	52.48	52.23	53.49	53.64	53.42	51.82	52.60	53.47	52.41	52.24	52.78	-0.22	0.66	98.75	99.58	0.42
54	53.11	52.83	53.25	53.51	54.15	52.84	53.54	54.53	53.64	53.98	53.54	-0.46	0.56	98.95	99.14	0.86

Water Level Height											Average (cm)	Bias	SD (σ)	Precision (%)	Accuracy (%)	Error (%)
US-015 (cm)	Gelam (cm)															
	1	2	3	4	5	6	7	8	9	10						
55	55.32	55.79	55.68	54.83	54.25	54.90	54.30	54.88	54.94	54.42	54.93	-0.07	0.54	99.02	99.87	0.13
56	56.60	57.04	55.98	55.97	57.45	55.45	55.58	56.30	56.36	56.23	56.30	0.30	0.62	98.90	99.47	0.53
57	57.04	57.66	56.78	57.21	56.88	57.26	57.02	57.88	56.71	58.52	57.30	0.30	0.57	99.01	99.48	0.52
58	58.65	58.00	58.84	58.12	58.13	57.91	59.79	57.01	57.42	58.75	58.26	0.26	0.79	98.65	99.55	0.45
59	58.69	58.05	58.45	58.69	58.27	58.47	58.89	59.20	58.73	59.57	58.70	-0.30	0.44	99.25	99.49	0.51
60	59.67	59.38	59.74	58.40	60.29	58.58	59.77	59.84	60.38	60.20	59.63	-0.38	0.67	98.87	99.38	0.63
61	59.45	60.33	61.54	61.07	60.49	60.24	60.21	60.30	58.85	60.92	60.34	-0.66	0.77	98.72	98.92	1.08
62	62.56	61.42	61.75	61.79	63.07	61.72	63.03	63.13	62.94	61.15	62.26	0.26	0.77	98.77	99.59	0.41
63	61.95	64.25	62.49	61.46	62.16	63.40	63.25	62.79	62.51	62.04	62.63	-0.37	0.82	98.69	99.41	0.59
64	64.45	64.68	63.96	64.52	64.07	65.07	64.31	64.54	66.29	63.61	64.55	0.55	0.73	98.86	99.14	0.86
65	65.66	65.36	65.00	64.69	64.73	64.83	64.89	64.15	64.80	64.99	64.91	-0.09	0.40	99.38	99.86	0.14
66	66.09	65.38	65.59	64.76	66.25	65.16	65.12	64.09	66.57	65.00	65.40	-0.60	0.75	98.86	99.09	0.91
67	67.91	67.35	66.94	67.20	66.78	67.89	67.66	67.58	66.33	66.91	67.26	0.25	0.52	99.23	99.62	0.38
68	68.10	67.43	69.41	67.93	68.01	68.42	68.23	67.88	67.13	68.61	68.12	0.12	0.63	99.08	99.83	0.17
69	68.07	68.81	68.58	69.52	69.58	68.01	67.67	68.94	69.61	68.20	68.70	-0.30	0.71	98.97	99.56	0.44
70	70.93	71.30	70.38	69.89	70.53	71.31	69.13	70.73	70.43	71.00	70.56	0.56	0.67	99.05	99.20	0.80
71	71.53	71.46	72.69	71.62	70.14	72.42	72.01	71.02	70.74	72.93	71.66	0.66	0.88	98.77	99.08	0.92
72	71.62	72.07	70.88	71.84	72.10	72.94	72.06	70.53	71.63	71.30	71.70	-0.30	0.68	99.05	99.58	0.42
73	73.71	72.32	74.40	73.84	72.86	74.85	73.86	75.51	73.71	73.42	73.85	0.85	0.92	98.76	98.84	1.16
74	73.01	73.09	73.24	73.26	72.60	73.71	73.44	73.70	73.61	73.90	73.36	-0.64	0.39	99.46	99.13	0.87
75	74.53	76.88	75.50	74.19	74.64	74.41	74.23	76.13	75.55	76.33	75.24	0.24	0.97	98.71	99.68	0.32
76	76.64	75.69	75.79	76.04	75.13	75.70	76.20	73.53	76.22	76.05	75.70	-0.30	0.86	98.86	99.60	0.40
77	76.70	76.56	75.81	76.72	76.65	75.74	76.41	76.04	76.11	77.05	76.38	-0.62	0.43	99.43	99.19	0.81
78	78.46	79.96	78.62	77.05	77.40	75.89	77.89	78.86	76.49	77.13	77.78	-0.22	1.22	98.43	99.71	0.29
79	79.32	78.40	78.23	76.95	77.86	79.01	79.23	77.60	78.71	77.52	78.28	-0.72	0.80	98.98	99.09	0.91
80	79.12	80.94	78.19	79.35	79.24	80.58	79.79	80.35	80.03	78.82	79.64	-0.36	0.85	98.93	99.55	0.45
81	79.62	79.08	80.99	80.51	80.53	78.90	81.59	81.84	81.03	81.22	80.53	-0.47	1.02	98.73	99.42	0.58
82	82.87	82.70	83.09	83.49	82.80	82.40	82.13	81.66	80.99	82.20	82.43	0.43	0.73	99.12	99.47	0.53
83	83.13	82.78	83.29	83.26	82.13	81.83	83.11	83.01	84.20	82.99	82.97	-0.03	0.65	99.22	99.97	0.03
84	83.71	83.11	82.94	82.22	82.89	83.03	82.82	82.65	82.84	83.97	83.02	-0.98	0.50	99.40	98.83	1.17
85	84.29	84.31	84.13	83.90	85.55	85.01	83.14	84.53	85.99	85.91	84.68	-0.32	0.92	98.91	99.62	0.38
86	87.28	86.69	86.74	86.51	86.81	85.88	87.91	87.39	86.82	86.35	86.84	0.84	0.57	99.34	99.03	0.97
87	87.71	88.87	88.28	88.32	87.52	87.60	88.28	86.02	88.97	87.61	87.92	0.92	0.85	99.04	98.94	1.06

Gelam Wood Sensor Application in Water Level Monitoring of a Campus Lake

Field testing to monitor the water level of the campus lake has been carried out from June 6, 2025 at 9 am to June 8, 2025 at 9.59 am. Water level data is measured every 15 minutes so that there are 197 data collected by the Gelam wood sensor and ultrasonic sensor. Photos of the field implementation is as shown in Figure 6. The results of this field measurement are shown in Figure 7. The data measured by the Gelam wood sensor are more fluctuating than the ultrasonic sensor readings which are in the range of 61.8 to 62.2. The Gelam wood sensor recorded the lowest water level at 60.6 and the highest at 63.4. Thus, there is a difference in reading of around 1.9%. These whole data was shown in the website at https://fisika-mipa-unsri.com/data/air.php.

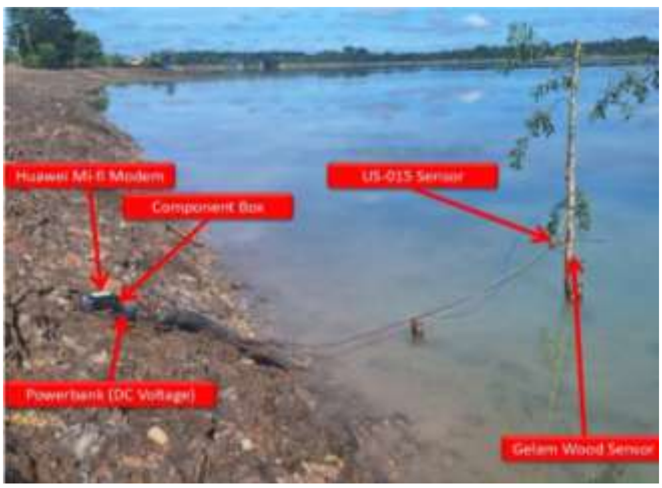

Figure 6. Gelam wood sensor application in monitoring water level height in a lake

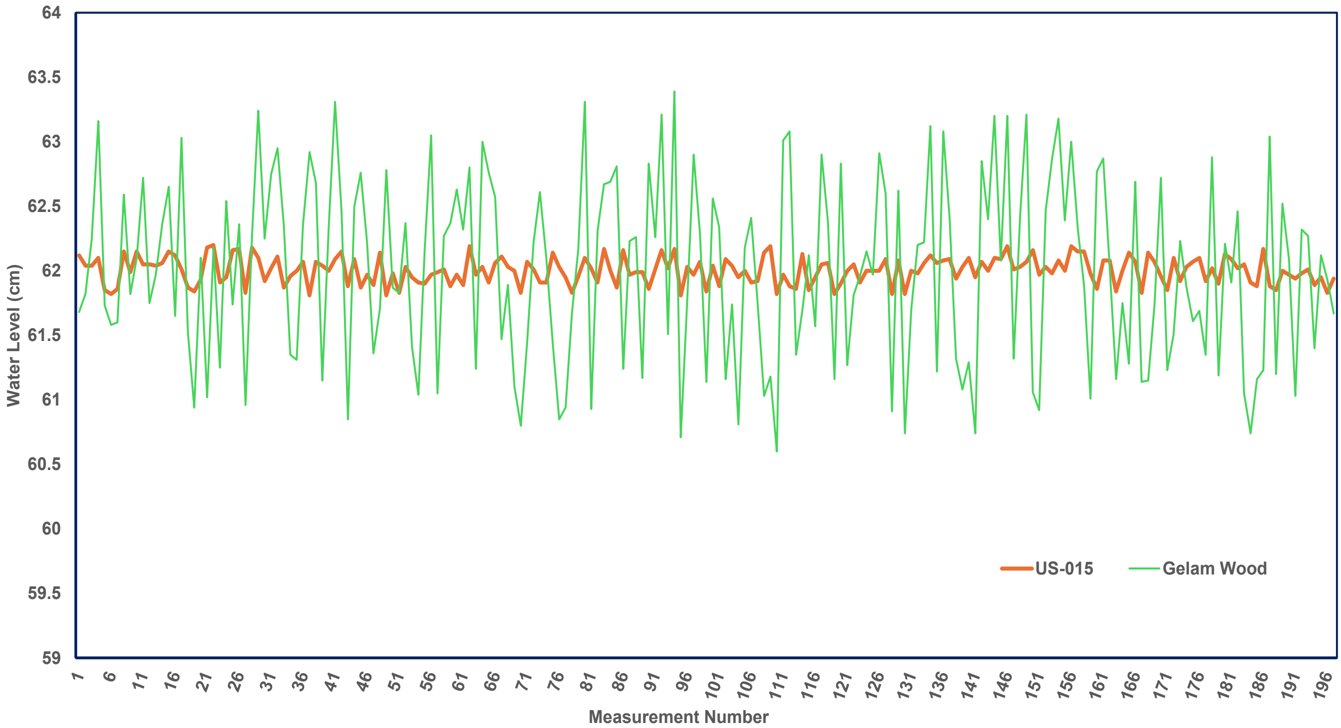

Figure 7. Data of water level height of a campus lake with 15 minutes interval measurement of Gelam wood sensor compare with US-015 sensor

Conclusion

A sensor system is a crucial component in any measurement that utilizes a sensing element that interacts with its environment resulting the initiation of a signal. The sensing system comprises three main components: the sensing element, the transducer, and the output unit. In this work, we designed a Gelam wood sensor as a sensing element, a voltage divider circuit as a transducer and a modem connected to a website as the output unit. The accuracy of the sensor is 98% with a resolution of about 1 cm in height. The speed at which the sensor reacts to changes in the water height is in a few seconds so its response time is fast response. The system design was successfully run for monitoring the water level height of a campus lake by real-time measurement. The results can be accepted as a valid measurement since the comparison output with a calibrated ultrasonic sensor showed similar data of water height with a 1.9% error. Therefore, the use of Gelam wood as a water level measurement sensor can be developed towards the realization of 'green electronics' to obtain energy efficiency in producing an electronic component; eco-friendly and non-toxic materials thus it can reduce the electronic waste accumulated every year. In the future, this system can be applied in peat land in the South Sumatra area to mitigate the wildfire or flooding annual risk.

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Author Contributions

Conceptualization, I.I. and K.S.; methodology, A and K.S.; software, K.S; validation, I.I.; formal analysis, A and K.S.; investigation, K.S.; resources, A and K.S.; data curation, A and K.S.; writing—original draft preparation, A.; writing—review and editing, A.; visualization, A and K.S.; supervision, I.I and A.; project administration, A and K.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest.

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