A Comparison of the Functionality
of the IR and Sonar Distance Sensors
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1 Introduction

The Botball kit comes with two different distance sensors, the IR (top hat) sensor and the sonar sensor. However, there are several limitations to the functionality of infrared and sonar sensors, such as the fact that Sonar won't pick up foam balls, and IR will have difficulty detecting objects such as clear plastic, water, and glass due to their high transparency. This paper will compare the functionality of the two sensors.

2 The Tests

We will perform two separate tests on the two sensors. We will use the same program for both tests. The program below is the program we used to do both the distance functionality tests and the material identification tests.

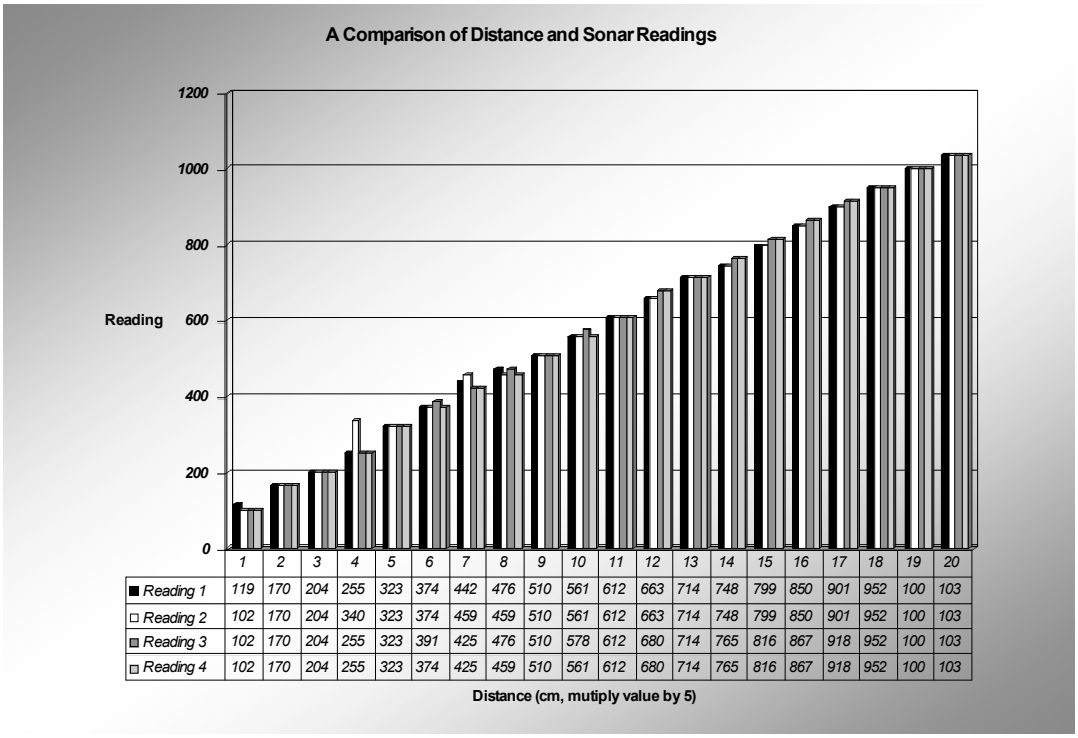
```
#define sound 8
#define IR 0
void main()
{
   while(1)
     {
       read();
       sleep(.5);
   }
}
void read()
{
   int r;
   display_clear();
   r=sonar(8);
   printf("S: %d\nIR: %d\n",r, analog(IR));
}
```

This program will collect data about the distance between the robot and the object we are currently

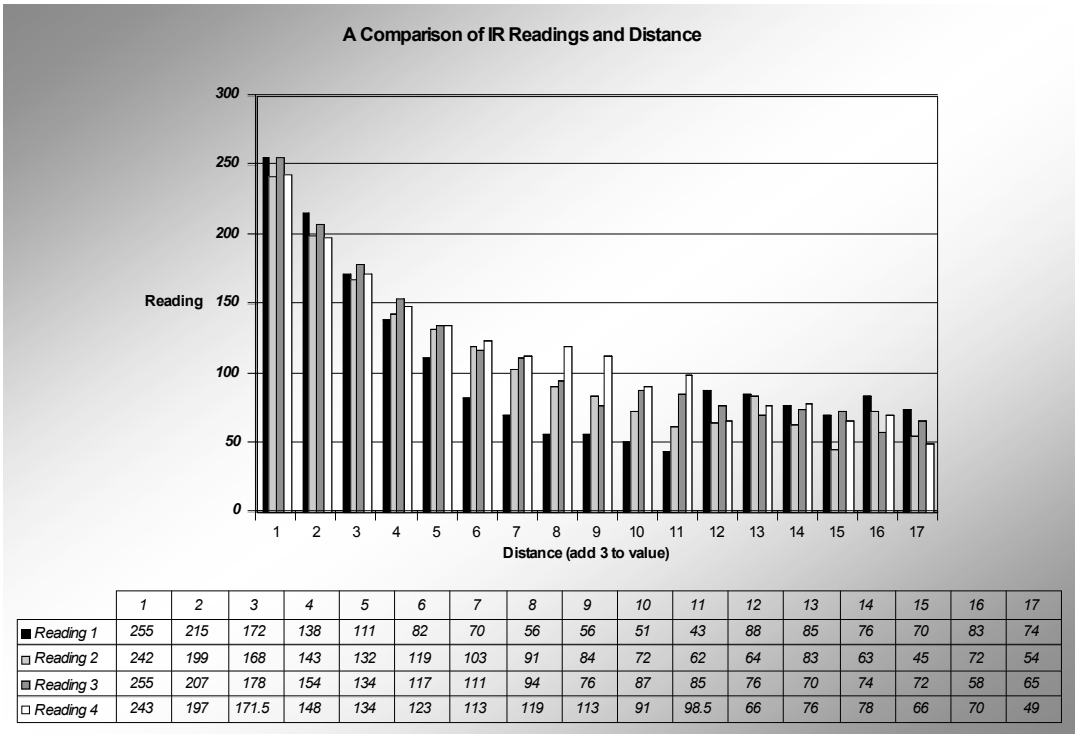
using. It activates the IR and sonar sensors attached to the robot, and then displays the results on the GBA screen.

2.1 Distance Functionality

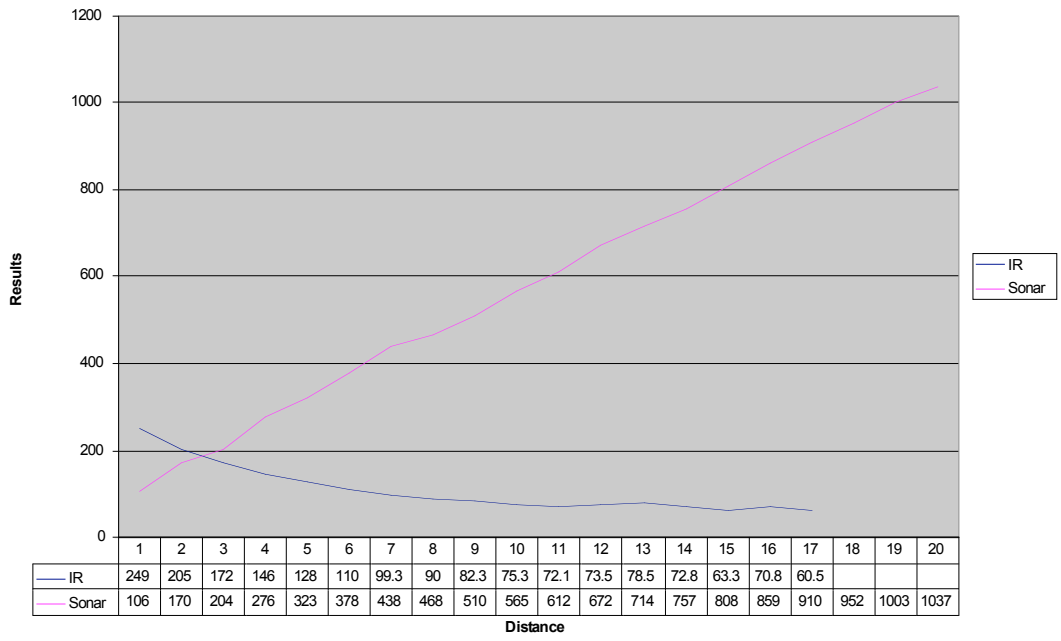
Our first test was to test the accuracy of the two sensors. To begin with, we downloaded the program onto our XBC and made a Lego "wall", which we set alongside a meter stick. We then started the robot and took readings, moving the wall slowly down the meter stick. We recorded the values displayed at each distance. The results are as follows:



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Reading 1	119	170	204	255	323	374	442	476	510	561	612	663	714	748	799	850	901	952	100	103
Reading 2	102	170	204	340	323	374	459	459	510	561	612	663	714	748	799	850	901	952	100	103
Reading 3	102	170	204	255	323	391	425	476	510	578	612	680	714	765	816	867	918	952	100	103
Reading 4	102	170	204	255	323	374	425	459	510	561	612	680	714	765	816	867	918	952	100	103

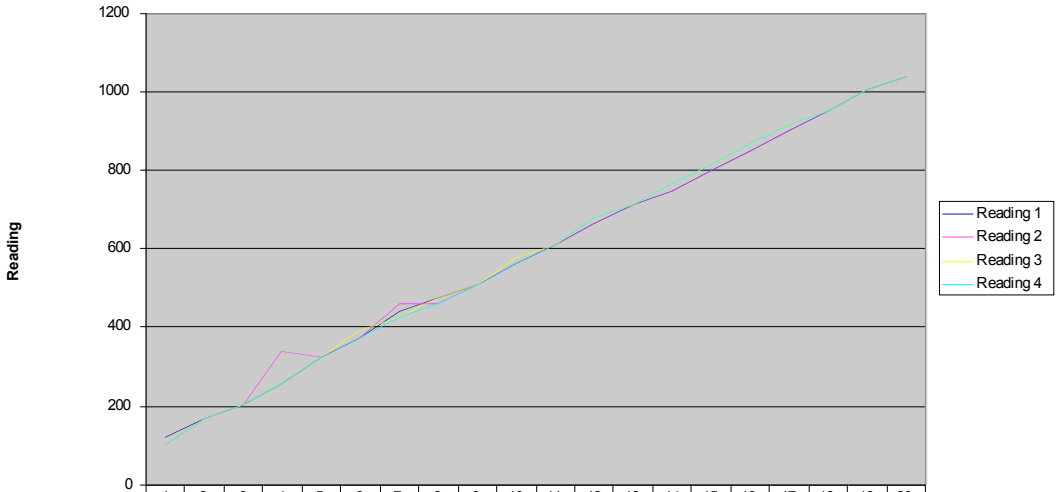


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Reading 1	255	215	172	138	111	82	70	56	56	51	43	88	85	76	70	83	74
Reading 2	242	199	168	143	132	119	103	91	84	72	62	64	83	63	45	72	54
Reading 3	255	207	178	154	134	117	111	94	76	87	85	76	70	74	72	58	65
Reading 4	243	197	171.5	148	134	123	113	119	113	91	98.5	66	76	78	66	70	49



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
IR	249	205	172	146	128	110	99.3	90	82.3	75.3	72.1	73.5	78.5	72.8	63.3	70.8	60.5			
Sonar	106	170	204	276	323	378	438	468	510	565	612	672	714	757	808	859	910	952	1003	1037

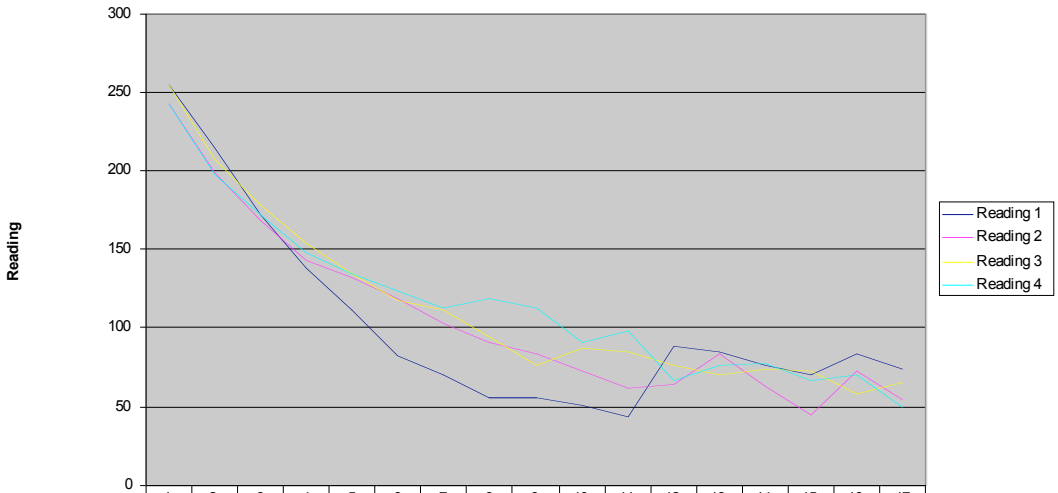
A Comparison of Sonar Results and Distance



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Reading 1	119	170	204	255	323	374	442	476	510	561	612	663	714	748	799	850	901	952	1003	1037
Reading 2	102	170	204	340	323	374	459	459	510	561	612	663	714	748	799	850	901	952	1003	1037
Reading 3	102	170	204	255	323	391	425	476	510	578	612	680	714	765	816	867	918	952	1003	1037
Reading 4	102	170	204	255	323	374	425	459	510	561	612	680	714	765	816	867	918	952	1003	1037

Distance

A Comparison of IR Results and Distance



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Reading 1	255	215	172	138	111	82	70	56	56	51	43	88	85	76	70	83	74
Reading 2	242	199	168	143	132	119	103	91	84	72	62	64	83	63	45	72	54
Reading 3	255	207	178	154	134	117	111	94	76	87	85	76	70	74	72	58	65
Reading 4	243	197	171.5	148	134	123	113	119	113	91	98.5	66	76	78	66	70	49

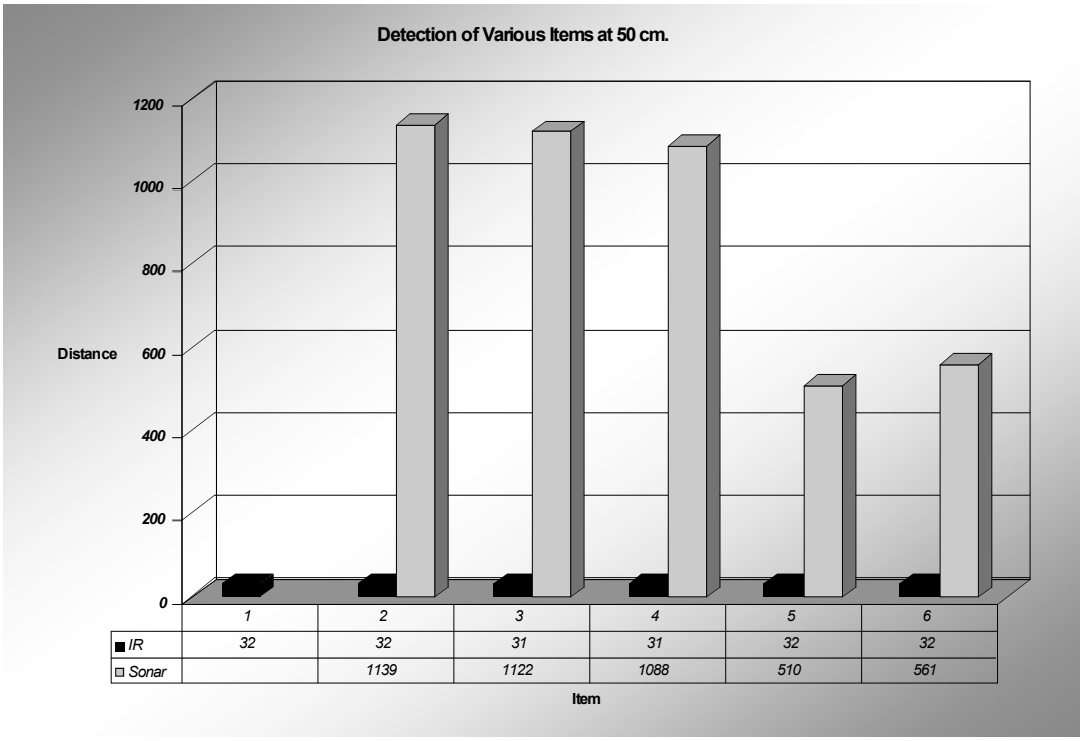
Distance

The results clearly show that sonar is much more reliable than IR at longer ranges unless you average out the results per distance, and that it is much harder to get the same results twice with the IR sensor. The sonar is clearly more accurate as the graph of its distance vs. reading is close to a straight line and nearly the same every test, the IR sensor is curved and jumps around,

especially at longer distances.

2.2 Test Two

This test was to find out which Botball materials IR and sonar would detect at 50 cm. As you can see, sonar would not very well detect any non-PVC items, and IR functioned almost perfectly, reading the same thing each time.



Here is a copy of the information this graph was made from.

	botguy	orange ball	blue ball	tribbles	large PVC	small PVC
IR	32	32	31	31	32	32
Sonar	no results	1139	1122	1088	510	561

The results show that the non-PVC Botball items were not read by the sonar, and the sensor was reading some item behind them at about 1.1 meters in distance. However, the IR, even though it was about 19¾ inches away, a distance at which it did not function well at all, had almost no variation in its readings.

3 Conclusion

Reviewing the results, it is hard to say whether IR or sonar is the better sensor for Botball, due to the fact that sonar will detect the denser items at a farther range than IR and give an accurate result, but IR will feed back almost the exact same reading for any Botball materials. Therefore, it can be determined that in Botball, neither IR or sonar works better than the other across the board. If you are only trying to detect the hard items like PVC materials and you want an accurate distance the sonar is clearly the way to go, however if you only want to know if

something is in front of you and you don't care about an exact and accurate distance the IR sensor is the way to go. A better solution might be to use both sensors at the same time using each to verify the other's results.