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A Mini-Maker Faire

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Session XXXX

A Mini-Maker Faire via Zoom

Abstract

Maker Culture can be used in Engineering Technology programs to enhance student learning. One of the major activities in the implementation of Maker Culture is holding a Mini-Maker Faire at the end of the semester for students to show their designs of products. Student teams are supposed to do demonstrations and presentations in the Min-Maker Faire. Covid-19 presented a challenge for the implementation of Maker Culture in the Electronic Systems Engineering Technology program. In particular, the organization of the Mini-Maker Faire was difficult to hold due to the room occupancy and social distancing limitations imposed by the university. To make things worse, at this stage of the implementation, the Mini-Maker Faire was supposed to involve students from two universities. Based on the circumstance, a decision was made to conduct the Mini-Maker Faire using Zoom. This paper discusses the details of Maker Culture implementation in the Fall semester of 2020.

Introduction

Maker Culture is a grassroots movement for learning, designing, and building gadgets[1,5,9]. It is a popular movement among hobbyists, engineers, and tinkers as a way of informal learning while having fun together. The first issue of Make magazine was published in 2005. Since Maker Culture involves different levels of learning in Bloom's taxonomy[2,3], it has become an attractive way of enhancing student learning[8,10]. Maker Culture works well in particular for Engineering Technology (ET) students because Maker Culture involves making and building things, which are the preferred way of learning for ET students[14,15].

Make Faires are events to celebrate Maker Culture. The first Maker Faire was held in 2006. Smaller scale Maker Faires are called Mini-Maker Faires. Extensive research work has been carried out in the area of Maker Culture[4,6,11].

While it was implemented in many engineering programs[10-12], Make Culture is more appropriate for Engineering Technology programs. Engineering programs typically spend more time in theoretical studies and application of mathematical and scientific principles for problem solving purposes and development of physical artifacts is often of secondary importance. Engineering technology programs, on the other hand, emphasize more on hands-on learning thus more closely connected to Maker Culture[13-15].

Texas A&M University and Prairie View A&M University have been working together to use Maker Culture to enhance student learning since the Fall semester of 2019[12,13]. Steady progress had been made until Covid-19 caused the lock-down of both campuses in Spring 2020.

In Fall semester of 2020, the campuses were open, but severe limitation for lab access was imposed. The laboratory room that normally can be used for 16 students allowed only four students to be in the room at the same time. The biggest challenge was the organization of Mini-Maker Faire at the end of the semester. There were a total of 74 students in the Control Systems course, which was being used for Maker Culture implementation. Considering the social distancing requirement, there was no room big enough that was available for the Mini-Maker Faire. According the original plan, the Mini-Maker Faire would involve students from both universities.

One option was to stop the implementation of Maker Culture until Covid-19 goes away. Of course, nobody knew when that would happen. The other option was to do as many things online as possible. This paper discusses the detail implementation of Maker Culture in the Electronic Systems Engineering Technology (ESET) program at Texas A&M University with Prairie View A&M University participating as reviewers of the projects. The focus is on the organization of the Mini-Maker Faire and the related evaluations.

Course Project

Students in the Control Systems course were told in the first lecture that they were expected to form teams to create a product. The only requirement was that some concepts in control systems must be used in designing the product. Students got to choose their own projects. They would work on the project during laboratory times. A Mini-Maker Faire would be held for project presentation. The only deviation from Maker Faire was the requirement of submitting a final project report for each team. While Maker Faires are informal and only involve informal presentation, the final project report requirement was added to satisfy ABET requirements on writing.

Team formation was completed in the first laboratory session. Each team started brainstorming for project ideas immediately after the team formation. An abstract of 500 word or less must be submitted by each team to get the approval from the instructor.

The project rubrics were established as follows:

- Abstract: 10%
- External evaluation: 5% (These were done by Prairie View students)
- Internal evaluation: 10% (These were done by students in the control system course)
- Teammate evaluation: 15% (Evaluation of team members)
- Instructor: 60%

It was emphasized to students and the external evaluators that the focus for the projects were learning. Even if a team did not have a working prototype, they could still receive a high score if significant amount of learning could be shown.

During laboratory time that was allocated for project discussions, students met via Zoom in separate breakout rooms. The instructor and TA went into each breakout room to answer questions and check on project status.

Students could meet in-person as long as they follow university rules such as room capacity, social distancing, and wearing face masks. This allowed them to pass hardware/prototype from one another. In Fall 2020, students were allowed to order hardware they needed for their projects.

A design review was conducted in class where teams presented their products, the conceptual block diagram, and hardware/software design.

An example of student project is given as follows.

The team Buoy Boys wanted to build a control system that could be used to align the buoy with the underwater robot. This design was considered useful in determining the location of underwater robots. A buoy was connected to the underwater robot. Since GPS signal could not be received under water, a GPS receiver was installed on the buoy that remained on surface. If the buoy could be controlled to be floating right above the underwater robot, (i.e. $\theta = 0$, in Fig. 1), then the GPS location of the buoy could be used to indicate the location of the robot. Propellers on the buoy would be controlled to achieve $\theta \approx 0$.

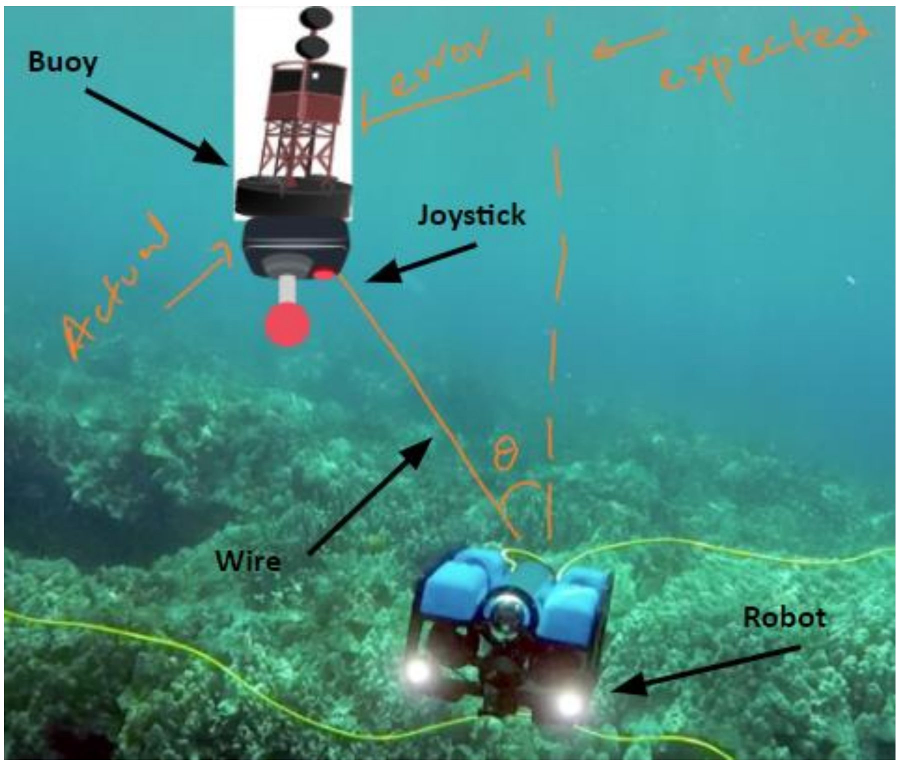

Figure 1. Conceptual Diagram for Buoy Boys

To accomplish this idea, a PID controller, which used a joystick position as input to generates a PWM signal for the DC motors, was implemented. The PWM signal depends on the error that is measured based on the joystick position. The joystick sensor sends the position information to the Arduino board which had PID control software in it. The DC motors had propellers attached to them so they could move the buoy in the desired direction.

The schematic design and the prototype are shown in Fig. 2.

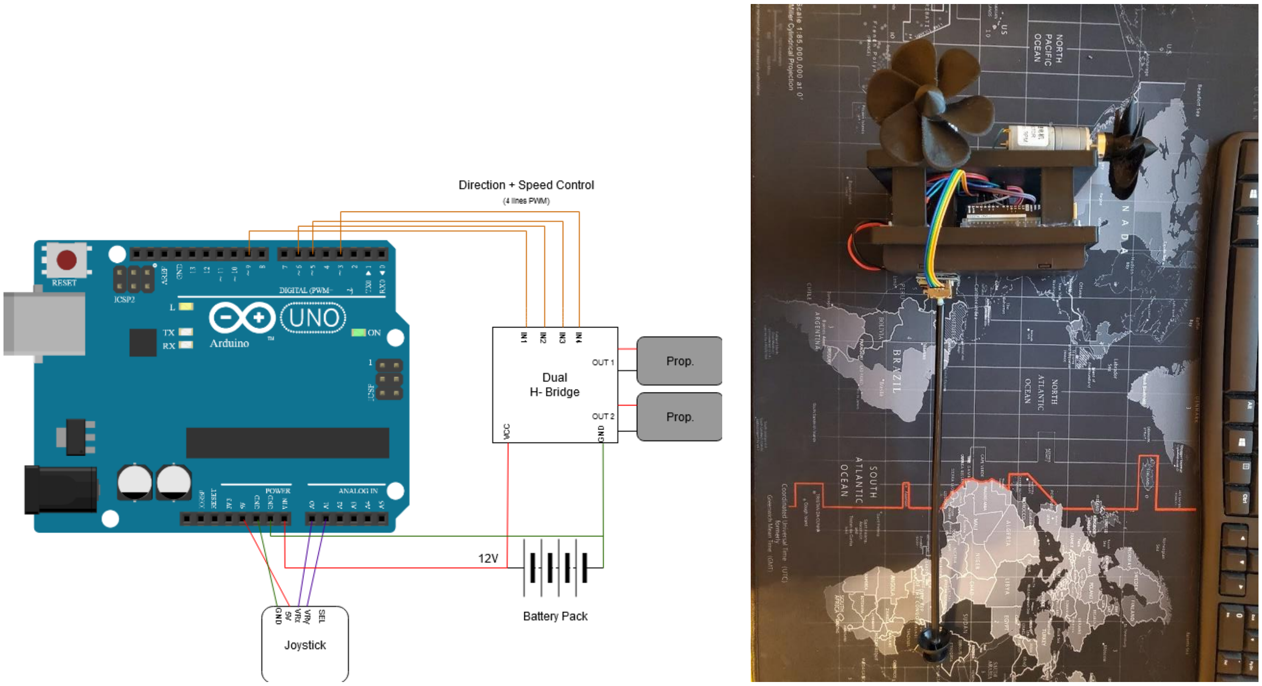

Figure 2. Schematic (left) and prototype (right) for Buoy Boys

Mini-Maker Faire

Based on the lessons learned during the Fall semester of 2019 and the constraints imposed by Covid-19, the Mini-Maker Faire held at the end of the Fall semester of 2020 was through Zoom. While online Maker community has been discussed by others as an option[7], it was the only choice that was available for us during Covid-19.

Many student teams used Zoom to record their presentations, while some teams used other video recording software to record individual presentations and then edit the videos to put together a presentation. The videos were limited to five minutes so that it would not take too much time for the external evaluators to complete the evaluation for all 15 projects. The Mini-Maker Faire was held during the last lecture of the semester. Video presentations were played during the Mini-Maker Faire. Video links were then sent out to Prairie View students to evaluate at their own time.

To give external evaluators access to the video presentations, the videos could not be uploaded to eCampus that was used for the course, instead, all videos were uploaded to YouTube as listed videos. All evaluators were provided with the YouTube link.

Every students in the course was required to conduct two evaluations: one for each of their teammates and one for other teams. Many years ago, similar evaluations were done using Excel form, which was very time consuming to put the results together. Now with online evaluations such as Google form, it is much easier to collect the data and calculate scores for each students.

Fig. 3 shows the Google form for internal evaluation. There are similar ones for external evaluation and teammate evaluation.

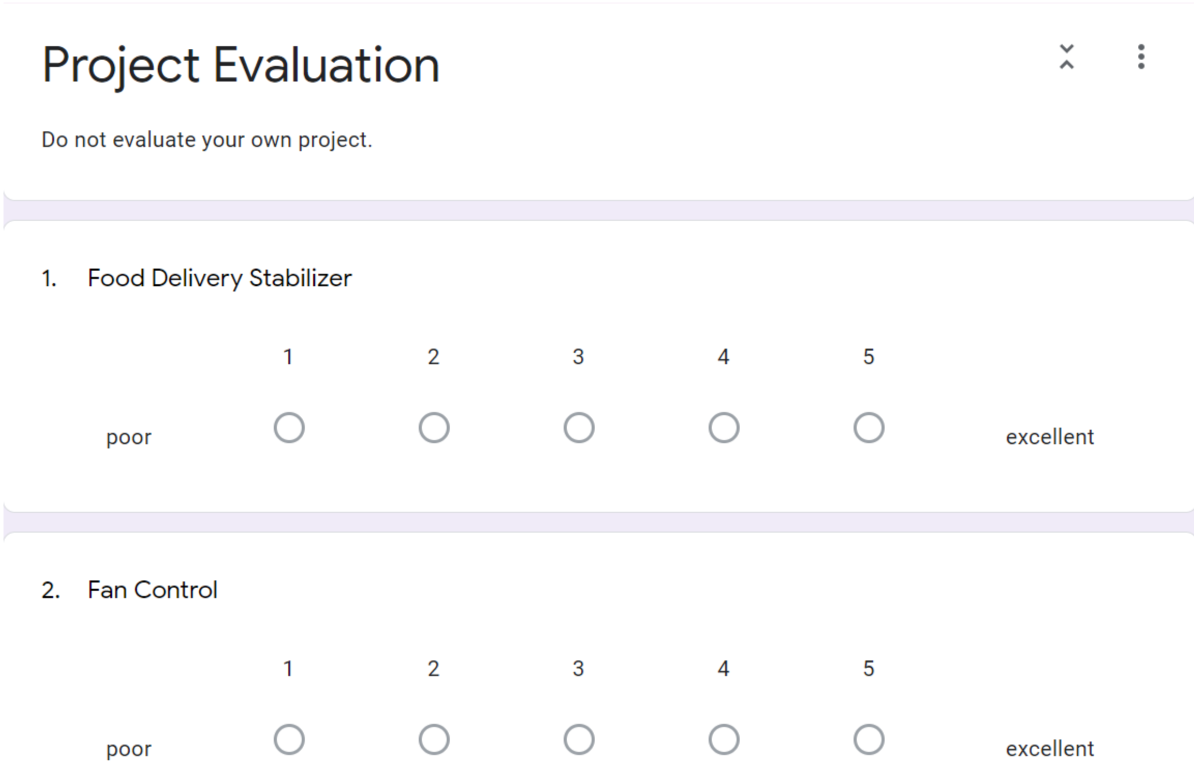

Figure 3. Google form for project evaluation (internal)

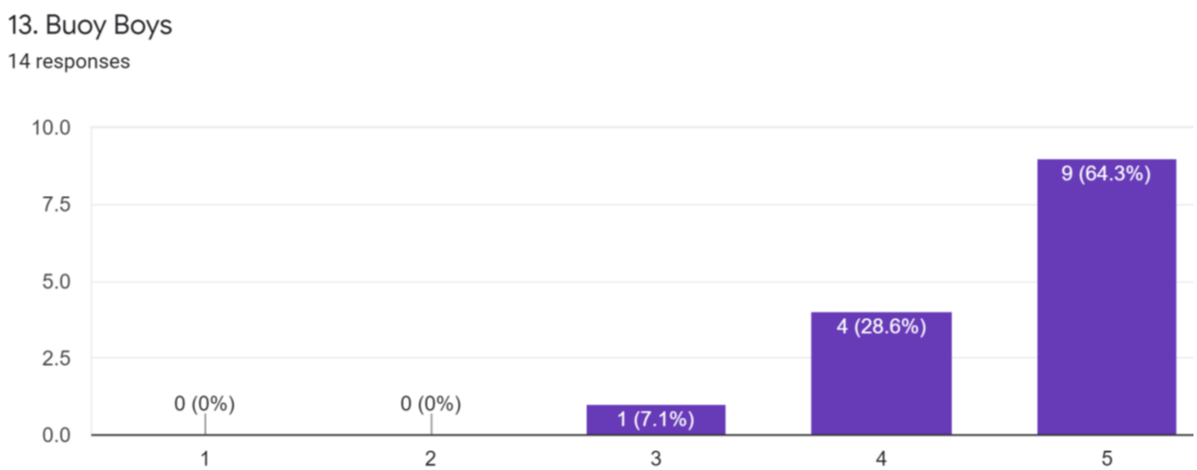

Figure 4. Graphical display for evaluation result for Buoy Boys

Additional Comments from external reviewers are displayed as follows:

- Overall each group gave a great presentation of their project
- I was very fascinated and inspired by all of these projects. They were all presented well with great information, great demos, and overall excellent YouTube presentations.

- I thought everyone did an awesome job on their projects. My favorite will have to be the Automated Greenhouse Control System. All the presenters did an excellent job demonstrating and explaining their projects clearly.
- I would like to add that A&M students did very great in this project and dedicated time
- Every group came up with great ideas and great execution.
- good job to everyone

With Google form, it is easy to export the evaluation result to Excel for further process, such as calculating the averages.

Mini-Maker Faire Evaluation Form (Responses)

File Edit View Insert Format Data Tools Form Add-ons Help Last edit was seconds ago

	A	D	F	G	H	I	J	K	L
1	Timestamp	Are you affiliated with	1. Food Delivery Stabilizer	2. Fan Control	3. Water Tank	4. Cat and Mouse	5. Greenhouse Control	6. Solar Panel Control	7. Robot Server
3	11/28/2020 20:18:09	TAMU	5	4	4	3	5	5	5
4	11/30/2020 12:47:20	PVAMU	4	4	4	5	5	5	5
5	12/1/2020 12:08:55	PVAMU	4	4	5	4	5	4	4
6	12/2/2020 0:00:19	PVAMU	4	5	4	4	4	4	4
7	12/2/2020 11:07:53	PVAMU	5	5	5	5	5	5	5
8	12/2/2020 16:39:41	PVAMU	5	5	5	5	5	5	5
9	12/2/2020 22:01:08	PVAMU	3	4	4	4	5	4	3
10	12/3/2020 8:50:48	PVAMU	4	3	4	3	3	3	
11	12/3/2020 10:56:07	PVAMU	5	4	4	5	5	5	5
12	12/3/2020 14:08:48	PVAMU	5	5	5	5	5	5	5
13	12/3/2020 19:45:15	PVAMU	5	5	5	5	5	5	5
14	12/3/2020 23:16:53	PVAMU	4	4	4	3	4	4	3
15	12/6/2020 18:37:44	PVAMU	5	5	5	4	5	5	5
16	12/7/2020 17:25:43	PVAMU	4	3	4	3	4	5	5
17	12/19/2020 16:49:52	PVAMU	4	4	4	3	4	4	3
18									

Figure 5. Evaluation results exported to Excel

The calculation of the project score for each students was done in Excel. It takes some time to set up the program to do the calculation. But once it is done, it is easy to copy and paste and be used in future. Fig. 6 shows the part that determines the score for each team, which was then combined with teammate evaluation to come up with the project score for each student.

Both external and internal evaluations used the 5-point Likert scale, which were linearly translated to percentages. This was done mostly for simplicity of evaluation. The weights for the these evaluators are relatively low, which is intentional for the first time implementation. The correlations among internal, eternal and instructor evaluations are reasonably good. This gives us confidence to increase the relative weighting for the internal/external evaluations in future. The 5-point Likert scale may be changed to 1-10 or 0-100 if necessary.

	Teams	ext(5%)	int(10%)	intr(60%)	tAvr
1	Food delivery	89.23	96.92	95	71.15
2	Fan Control	87.69	90.46	95	70.43
3	Water tank	89.23	90.15	90	67.48
4	Cat & Mouse	84.62	85.97	85	63.83
5	Greenhouse control	93.85	89.12	90	67.60
6	Solar Panel	90.77	93.13	90	67.85
7	Robot server	90.00	92.84	90	67.78
8	2 wheel robot	87.69	94.12	90	67.80

Figure 6. Project score calculation

Summary and Conclusions

In summary, Maker Culture was implemented in Control Systems course in the ESET program at Texas A&M University. A Mini-Maker Faire was successfully organized via Zoom. Video links were provided to students at Prairie View A&M for their evaluation of the projects. It allowed us to see how the Mini-Maker Faire worked in synchronous and asynchronous modes. Both modes worked reasonably well. There were significant amount of efforts involved in the project evaluations. Use of Google forms made the process easy to complete.

The main challenge for the Mini-Maker Faire was the social distancing rule during the pandemic. Students teams would work better when they can spend more time together working on their prototypes. The online Mini Maker Faire was a success, and the format for presentation and evaluation worked better than the in-person format. There was no issue related to the availability of large room for the Min-Maker Faire. It also solves the problem of transportation of students from one university to the other. The evaluation process is more flexible since it can be done at evaluators' convenience. This format will be implemented in future Mini-Maker Faire even after the pandemic is over.

Based on what was learned during the online Mini-Maker Faire, Texas A&M University and Prairie View A&M University plan to work together to hold a joint Mini-Maker Faire in the near future.

Data will be collected to evaluate the impact on student learning.

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