Grant Proposal for GEAR (Geauga Engineering and Robotics) 4-H Club

September 12, 2015

Club Background

GEAR is a new 4-H club in Geauga County, Ohio. The club's first meeting was held in February of 2014. GEAR currently has 28 members and 2 advisors. During 2014 and 2015, members of the club completed various activities designed to teach aspects of engineering and electronics. The club is currently divided into two groups. Juniors are in 3rd or 4th grade. Seniors are in fifth grade and above and are further divided into groups according to the number of years they have been in the Senior Group, one or two. This next year we will have a third year Senior group.

In 2014, the younger group completed portions of the Junk Drawer Robotics curriculum developed by the national 4-H organization (http://www.4-h.org/resource-library/curriculum/4-h-robotics/junk-drawer-robotics/) as well as additional activities selected by club advisors. In 2015 these members completed portions of the 4-H activity book ***Magic of Electricity*** and additional activities developed by club advisors focusing on electricity. For the 2016 4-H year, Juniors will be completing a 4-H curriculum on Simple Machines supplemented by light and sound experiments. Our goal is to prepare Juniors for graduating into the first year Senior curriculum by learning basic scientific and engineering concepts and doing experiments. Second year Juniors will also complete the *Magic of Electricity* project book.

The curriculum for first year senior members was focused on electronics and completion of a line-following robot in 2015. The same curriculum was completed by second year senior members in 2014. Returning senior members completed an infrared add-on module for their line-following robots in 2015. This module is designed to control traffic at intersections, causing the robot on the right to stop while the robot on the left clears the intersection. In addition, second year senior members completed a crystal radio project, including the winding of coils for the tuning and antenna circuits. The radio project also included the construction of a separate audio amplifier. Future new senior members will follow the same curriculum.

Upon completion of the two-year curriculum (http://lafavre.us/robotics/), senior members gain a basic foundation in electronics, including the construction of a robot comprised of many discrete electronic components in combination with several integrated circuits. The circuitry is first assembled on prototyping boards, with exercises designed to reveal the functioning of each component. After completing an exercise designed to teach soldering, members solder components and IC chips to circuit boards and complete additional wiring to finish the robots. The crystal radio project is designed to teach basic fundamentals of radio communication.

Robotics Platforms for Future Curriculum

With completion of these projects, our second year senior members are ready to take on more advanced projects. Up to this point, parents of club members and the advisors have supplied the funding for projects. Now that our advanced senior members are ready to tackle more sophisticated projects, the club is seeking funding to cover the anticipated curriculum for 2016. This curriculum will

employ relatively expensive robotics kits, which provide the opportunity for members to learn how to program autonomous robots and build radio controlled robots.

Club advisors have identified two robotics platforms that will be suitable for the 2016 curriculum. It should be noted that these robot kits are robust and should serve the club for many years. These robots, unlike the line-following robots, will remain in the club inventory rather than in individual ownership of club members.

ActivityBot, the first robotics platform selected, is offered by Parallax Inc. (https://www.parallax.com/product/32500)
The advisors have already purchased one ActivityBot for the purpose of evaluation and the advisors believe it is an excellent platform for introductory robotics. ActivityBot is a small robot capable of being programmed in C language. Club advisors believe that learning computer programming in C will be a challenging, yet obtainable goal for our older members. C is taught in many high school robotics programs and is often the language of choice in introductory computer programming courses in colleges and universities. Unlike some alternative robotics platforms, the programming software for ActivityBot is provided free of charge. This makes for an attractive package at an affordable price. The documentation for the ActivityBot is excellent and Parallax provides a nice set of free tutorials, which will be invaluable to club advisors in developing a curriculum around this robot. Parallax provides a robust set of additional sensors and other accessories to extend the capabilities of the basic kit. For example, there is a GPS module for receiving position data from satellites. The possibilities with this kit and available add-ons are many and it is anticipated that this platform will allow our members to be engaged in many robotics projects.

Tetrix Max, an intermediate-size robotics platform offered by Pitsco, is the other platform selected by GEAR club advisors. (http://www.tetrixrobotics.com/TETRIX_MAX/TETRIX_Starter_Set)
This is the more popular robotics platform of two used in the First Tech Challenge (FTC) - http://www.usfirst.org/roboticsprograms/ftc
The Tetrix Max base set would provide the opportunity for our members to work with a larger robot, capable of tasks not suited to a small robot. The base set allows the construction of a variety of robots that are radio controlled. There is no microcontroller in this kit, but it is possible to add a microcontroller from another source. The drive motors for the Tetrix kit are DC motors. In order to control the motors with a microcontroller, a suitable motor controller must be added as the intermediate component. A suitable motor controller is available from Parallax, which would allow the use of a Propellor board, the same board utilized in the ActivityBot. The Propellor board is an attractive choice for the Tetrix robot due to its relatively low cost and it would be advantageous because members would already be familiar with programming this microcontroller in C language.

There are a number of robotics competitions that attract club and school groups. Some of these involve high costs for participation and possibly travel out of state for events. While our parents and club members are interested in competitions, the cost and time commitments can be outside the limits for some families. GEAR advisors plan to institute intra-club robotics competitions as part of the robotics curriculum so that all of our members have the opportunity to participate in competitions near their homes without the high cost of registration fees. In addition, the advisors have identified the National Robotics Challenge, held in April of each year in Marion, Ohio, as a competition that would fit well with the club curriculum and one with reasonable entry fees (http://thenrc.org/). Interested GEAR members

could form teams to compete at the NRC in several events. For example, the ActivityBot robots could be used as entries in the Robot Maze and Mini Sumo contests. The Tetrix robots would be suitable for the Rescue Robot contest as well as others. We find the NRC attractive due to the lack of a requirement for specific robotics platforms, and the variety of contests within one robotics event. The club advisors attended the 2015 NRC as spectators to become better informed regarding the details of this event.

Funding Future Robotics Projects

The total cost to cover the robotics platforms and additional supplies is $5,017.31 plus shipping costs (see the included table for details). We plan to seek funding from several sources to meet the projected costs. GEAR has approximately $500 in our treasury at this time to devote to this project. In addition, we anticipate the receipt shortly of a grant from National 4-H for $1,000. We seek funding from other sources to cover the remaining costs. Our plan is to solicit contributions through online sources such as gofundme (http://www.gofundme.com/) and to solicit grants from engineering firms and similar enterprises. The cost of one ActivityBot is $170. Our goal is to obtain 10 of these robots, which would allow our members to work individually on programming a robot. The cost of one Tetrix Max robot is $600. Our goal is to obtain 4 of these robots. Members would work as teams of 2 or 3 with these robots. In addition, we have identified other items to expand the versatility of the above robots. These are listed in the table on the last page with the costs involved.

Club Advisors

Jeffrey La Favre

Jeff is head advisor for the GEAR club and works with the older club members (6th grade and up). He holds a Ph.D. in Soil Microbiology from the University of California, Riverside. Jeff has held research positions at Cornell University and in private industry. He is currently employed by John Carroll University as an instructional technologist. Jeff is an amateur astronomer and owns a robotically controlled telescope housed in an observatory that he constructed in his backyard.

Adrienne La Favre

Adrienne is a project advisor for the GEAR club and works with the younger group of club members. She is also head advisor of the Plantmasters 4-H club. She works for the Ohio EPA as an inspector. Adrienne holds a Ph.D. in Plant Physiology from Kent State University. She has held research positions at Cornell University and in private industry.

GEAR 4-H club grant proposal
parts list

Item	Source	part #	price each	number requred	total cost
ActivityBot robot	Parallax Inc.	32500	$169.15	10	$1,691.50
PAM-7Q GPS module	Parallax Inc.	28509	$49.99	1	$49.99
Sharp GP2Y0A02YK0F IR Distance Sensor 20-150 cm	Parallax Inc.	28997	$12.99	1	$12.99
Sharp GP2Y0A710K0F IR Distance Sensor 100-550 cm	Parallax Inc.	28999	$19.99	1	$19.99
Sharp GP2Y0A21YK0F IR Distance Sensor 10-80 cm	Parallax Inc.	28995	$11.99	1	$11.99
Sharp IR Sensor to Servo Cable	Parallax Inc.	805-28995	$3.50	1	$3.50
Gripper Kit for ActivityBot	Parallax Inc.	28202	$59.99	1	$59.99
QTI Line Follower AppKit	Parallax Inc.	28108	$29.99	1	$29.99
PIR Sensor (Rev B)	Parallax Inc.	555-28027	$10.99	1	$10.99
Parallax Standard Servo	Parallax Inc.	900-00005	$12.99	10	$129.90
Dual Motor Driver MC33926	Parallax Inc.	28820	$29.99	4	$119.96
Veho 360 Speaker	Parallax Inc.	900-00018	$14.99	2	$29.98
Propeller Activity Board	Parallax Inc.	32910	$49.99	4	$199.96
ActivityBot Speaker Mount	Parallax Inc.	725-32905	$3.99	2	$7.98
Tetrix MAX Starter set	Pitsco	W36256	$595	4	$2,380.00
TETRIX MAX Tank Tread Kit	Pitsco	W36468	$99.95	1	$99.95
TETRIX MAX Autonomous Mounting Deck	Pitsco	W37799	$15.95	4	$63.80
TETRIX MAX Rechargeable Battery Pack	Pitsco	W41135	$29.95	2	$59.90
NiMH Battery Pack Charger	Pitsco	W39830	$34.95	1	$34.95
					$5,017.31