CV Approval Cover Sheet

Complete this sheet and place it atop your completed forms before you scan and submit them.

Name: Aditya Kendre

Email: kendreaditya@gmail.com

Building: CVHS **Grade:** 11

Sponsor: Christopher Irvin **Email:** cirvin@cvschools.org

Required forms: *These forms must be completed for ALL projects.*

Sponsor initials

AK **1: Adult Sponsor Checklist** - Checklist and Sponsor Signature

AK **1A: Student Checklist** – Student and Project Details, plus the separate type-written **Research plan (i.e. title, problem, hypothesis, materials, procedure, and analysis) with five-source Bibliography.**

AK **1B: Approval form** - Signatures of student and parent/guardian, as well as signatures of SRC or IRB if required.

AK **3: Risk Assessment form** - required by the CV IRB in order to determine if the project involves hazardous chemicals (not found in a typical high school chemistry laboratory setting), hazardous activities or devices (i.e. weapons), and microorganism that are not exempt from pre-approval.

Potential forms: *Determined with your sponsor by using the Form Wizard.*

_____ **1C: Regulated Research / Institution setting** - for projects not completed at home or school.

_____ **2: Qualified Scientist form** - may be needed for projects that have human participants, vertebrate animals, potentially hazardous biological agents (including microbes) and DEA-controlled substances.

_____ **4: Human Participants form** - ALL projects that use human participants.
Human Informed Consent - required for each actively participating humans.

_____ **5A: Vertebrate Animal** - ALL non-exempt vertebrate projects conducted at home/school/field site

_____ **5B: Vertebrate Animal** - for vertebrate projects conducted in a Regulated Research Institution

_____ **6A: Potentially Hazardous Biological Agents Risk Assessment** - needed for microorganisms, rDNA, fresh/frozen tissues (including primary cell lines, human and other primate established cell lines and tissue cultures, blood, blood products and body fluids.

_____ **6B: Human and Vertebrate Animal Tissue** - for projects that use fresh/frozen tissues (including primary cell lines, human and other primate established cell lines and tissue cultures), blood, blood products and body fluids

_____ **7: Continuation/Research Progression** - Required for projects that are a continuation/progression in the same field of study as a previous project for this student. NOTE: The previous year's abstract and research plan must be included with the form.

Checklist for Adult Sponsor (1)

This completed form is required for ALL projects.

To be completed by the Adult Sponsor in collaboration with the student researcher(s):

Student's Name(s): Aditya Kendre

Project Title: A Deep Learning Approach for Arrhythmia Detection

1. ■ I have reviewed the Intel ISEF Rules and Guidelines.

2. ■ I have reviewed the student's completed Student Checklist (1A) and Research Plan/Project Summary.

3. ■ I have worked with the student and we have discussed the possible risks involved in the project.

4. ☐ The project involves one or more of the following and requires prior approval by an SRC, IRB, IACUC or IBC:
   - ☐ Humans
   - ☐ Vertebrate Animals
   - Potentially Hazardous Biological Agents
     - ☐ Microorganisms ☐ rDNA ☐ Tissues

5. ■ Items to be completed for **ALL PROJECTS**
   - ■ Adult Sponsor Checklist (1)
   - ■ Student Checklist (1A)
   - ■ Research Plan/Project Summary
   - ■ Approval Form (1B)
   - ☐ Regulated Research Institutional/Industrial Setting Form (1C) (when applicable; after completed experiment)
   - ☐ Continuation/Research Progression Form (7) (when applicable)

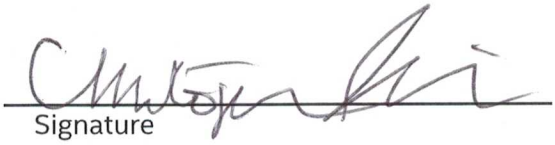
Additional forms required if the project includes the use of one or more of the following (check all that apply):

☐ **Humans,** including student designed inventions/prototypes. (Requires prior approval by an Institutional Review Board (IRB); see full text of the rules.)
- ☐ Human Participants Form (4) or appropriate Institutional IRB documentation
- ☐ Sample of Informed Consent Form (when applicable and/or required by the IRB)
- ☐ Qualified Scientist Form (2) (when applicable and/or required by the IRB)

☐ **Vertebrate Animals** (Requires prior approval, see full text of the rules.)
- ☐ Vertebrate Animal Form (5A) - for projects conducted in a school/home/field research site (SRC prior approval required.)
- ☐ Vertebrate Animal Form (5B) - for projects conducted at a Regulated Research Institution. (Institutional Animal Care and Use Committee (IACUC) approval required prior experimentation.)
- ☐ Qualified Scientist Form (2) (Required for all vertebrate animal projects at a regulated research site or when applicable)

☐ **Potentially Hazardous Biological Agents** (Requires prior approval by SRC, IACUC or IBC, see full text of the rules.)
- ☐ Potentially Hazardous Biological Agents Risk Assessment Form (6A)
- ☐ Human and Vertebrate Animal Tissue Form (6B) - to be completed in addition to Form 6A when project involves the use of fresh or frozen tissue, primary cell cultures, blood, blood products and body fluids.
- ☐ Qualified Scientist Form (2) (when applicable)
- ☐ The following are exempt from prior review but require a Risk Assessment Form 3: projects involving protists, archae and similar microorganisms, for projects using manure for composting, fuel production or other non-culturing experiments, projects using color change coliform water test kits, microbial fuel cells, and projects involving decomposing vertebrate organisms.

☐ **Hazardous Chemicals, Activities and Devices** (No SRC prior approval required, see full text of the rules.)
- ☐ Risk Assessment Form (3)
- ☐ Qualified Scientist Form (2) (required for projects involving DEA-controlled substances or when applicable)

Christopher Irvin		10/29/2019
Adult Sponsor's Printed Name	Signature	Date of Review (mm/dd/yy)
717-736-2227	cirvin@cvschools.org	
Phone	Email	

Student Checklist (1A)

This form is required for ALL projects.

1. a. Student/Team Leader: Aditya Kendre Grade: 11

   Email: kendreaditya@gmail.com Phone: (717) 622 1281

   b. Team Member: _____ c. Team Member: _____

2. Title of Project:

   A Deep Learning Approach for Arrhythmia Detection

3. School: Cumberland Valley HS School Phone: (717) 697-8261

   School Address: 6746 Carlisle Pike
   Mechanicsburg, PA 17050

4. Adult Sponsor: Christopher Irvin Phone/Email: cirvin@cvschools.org

5. Does this project need SRC/IRB/IACUC or other pre-approval? ☐ Yes ■ No Tentative start date: _____

6. Is this a continuation/progression from a previous year? ☐ Yes ■ No
   If Yes:
   a. Attach the previous year's ☐ Abstract **and** ☐ Research Plan/Project Summary
   b. Explain how this project is new and different from previous years on
   ☐ Continuation/Research Progression Form (7)

7. This year's laboratory experiment/data collection:

   10/20/19 (Actual Start Date: (mm/dd/yy)) 12/20/19 (End Date: (mm/dd/yy))

8. Where will you conduct your experimentation? (check all that apply)
   ☐ Research Institution ☐ School ☐ Field ■ Home ☐ Other: _____

9. List name and address of all non-home and non-school work site(s):

   Name: _____ _____

   Address: _____ _____

   _____ _____

   Phone/ email _____ _____

10. **Complete a Research Plan/Project Summary following the Research Plan/Project Summary instructions and attach to this form.**

11. **An abstract is required for all projects after experimentation.**

Research Plan/Project Summary Instructions

A complete Research Plan/Project Summary is required for ALL projects and must accompany Student Checklist (1A).

1. All projects must have a Research Plan/Project Summary
   a. Written prior to experimentation following the instructions below to detail the rationale, research question(s), methodology, and risk assessment of the proposed research.
   b. If changes are made during the research, such changes can be added to the original research plan as an addendum, recognizing that some changes may require returning to the IRB or SRC for appropriate review and approvals. If no additional approvals are required, this addendum serves as a project summary to explain research that was conducted.
   c. If no changes are made from the original research plan, no project summary is required.

2. Some studies, such as an engineering design or mathematics projects, will be less detailed in the initial project plan and will change through the course of research. If such changes occur, a project summary that explains what was done is required and can be appended to the original research plan.

3. The Research Plan/Project Summary should include the following:
   a. **RATIONALE:** Include a brief synopsis of the background that supports your research problem and explain why this research is important and if applicable, explain any societal impact of your research.
   b. **RESEARCH QUESTION(S), HYPOTHESIS(ES), ENGINEERING GOAL(S), EXPECTED OUTCOMES:** How is this based on the rationale described above?
   c. Describe the following in detail:
      - **Procedures:** Detail all procedures and experimental design including methods for data collection. Describe only your project. Do not include work done by mentor or others.
      - **Risk and Safety:** Identify any potential risks and safety precautions needed.
      - **Data Analysis:** Describe the procedures you will use to analyze the data/results.
   d. **BIBLIOGRAPHY:** List major references (e.g. science journal articles, books, internet sites) from your literature review. If you plan to use vertebrate animals, one of these references must be an animal care reference.

Items 1–4 below are subject-specific guidelines for additional items to be included in your research plan/project summary as applicable.

1. Human participants research:
   a. Participants: Describe age range, gender, racial/ethnic composition of participants. Identify vulnerable populations (minors, pregnant women, prisoners, mentally disabled or economically disadvantaged).
   b. Recruitment: Where will you find your participants? How will they be invited to participate?
   c. Methods: What will participants be asked to do? Will you use any surveys, questionnaires or tests? If yes and not your own, how did you obtain? Did it require permissions? If so, explain. What is the frequency and length of time involved for each subject?
   d. Risk Assessment: What are the risks or potential discomforts (physical, psychological, time involved, social, legal, etc.) to participants? How will you minimize risks? List any benefits to society or participants.
   e. Protection of Privacy: Will identifiable information (e.g., names, telephone numbers, birth dates, email addresses) be collected? Will data be confidential/anonymous? If anonymous, describe how the data will be collected. If not anonymous, what procedures are in place for safeguarding confidentiality? Where will data be stored? Who will have access to the data? What will you do with the data after the study?
   f. Informed Consent Process: Describe how you will inform participants about the purpose of the study, what they will be asked to do, that their participation is voluntary and they have the right to stop at any time.

2. Vertebrate animal research:
   a. Discuss potential ALTERNATIVES to vertebrate animal use and present justification for use of vertebrates.
   b. Explain potential impact or contribution of this research.
   c. Detail all procedures to be used, including methods used to minimize potential discomfort, distress, pain and injury to the animals and detailed chemical concentrations and drug dosages.
   d. Detail animal numbers, species, strain, sex, age, source, etc., include justification of the numbers planned.
   e. Describe housing and oversight of daily care
   f. Discuss disposition of the animals at the termination of the study.

3. Potentially hazardous biological agents research:
   a. Give source of the organism and describe BSL assessment process and BSL determination.
   b. Detail safety precautions and discuss methods of disposal.

4. Hazardous chemicals, activities & devices:
   - Describe Risk Assessment process, supervision, safety precautions and methods of disposal.
   - Material Safety Data Sheets are not necessary to submit with paperwork.

ECG-Based Abnormal Heartbeat Classification: A Deep Learning Approach for Arrhythmia Detection

Aditya Kendre

Cumberland Valley High School

Rationale

Electrocardiograms (ECG) have created a profound impact in the field of cardiology, specify in recognizing of heart arrhythmias. Non-invasive arrhythmia analysis is based on 10 electrodes that reflect the electrical activity on ECGs. An estimated three million cases of arrhythmia occur in the United States yearly (Mayo Clinic). Diagnosing this disease early is the key to one's wellness, yet 18% of cardiologists misinterpreted ECGs containing atrial fibrillation (Anh et al, 2006). With the recent advancements in technology, Machine Learning algorithms such as Deep Neural Networks (DNNs), allow a computer to learn features and identify patterns within a given dataset. On the basic level, DNNs receive input data, and through a series of weights and biases, outputs a confidence value in all possible labels of the dataset, similar to a human's neural network. Furtherance in the accuracy of abnormal heartbeat classification will allow cardiologists to accurately, and efficiently recognizing arrhythmia before becoming prevalent in one's wellbeing.

Research

Research Question: This research project will examine whether a classifier will be able to accurately identify abnormal heartbeat in ECGs.

Hypothesis: If an image classifier received a supervised dataset of heart arrhythmia of ECGs, then the image classifier will allow an accurate identification of arrhythmia.

Expectation: The image classifier should reach an accuracy of above 82%.

Procedure:

1. Gather a dataset of annotated ECGs
2. Determine type of classifier used to learn dataset features
3. Analyze results using Gradient Decent and Mean Loss function

Risks and Safety:

This research project involves no risks or safety concerns.

References

Alfaras, Miquel, Soriano, & Silvia. (2019, July 3). A Fast Machine Learning Model for ECG-Based Heartbeat Classification and Arrhythmia Detection. Retrieved October 30, 2019, from https://www.frontiersin.org/articles/10.3389/fphy.2019.00103/full.

Mayo Clinic. (2019, April 2). Heart arrhythmia. Retrieved October 30, 2019, from https://www.mayoclinic.org/diseases-conditions/heart-arrhythmia/symptoms-causes/syc-20350668?utm_source=Google&utm_medium=abstract&utm_content=Cardiac-arrhythmia&utm_campaign=Knowledge-panel.

Srinivasan, N. T., & Schilling, R. J. (2018, June). Sudden Cardiac Death and Arrhythmias. Retrieved October 30, 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6020177/.

Approval Form (1B)

A completed form is required for each student, including all team members.

1. To Be Completed by Student and Parent

a. Student Acknowledgment:

- I understand the risks and possible dangers to me of the proposed research plan.
- I have read the Intel ISEF Rules and Guidelines and will adhere to all International Rules when conducting this research.
- I have read and will abide by the following Ethics statement

Student researchers are expected to maintain the highest standards of honesty and integrity. Scientific fraud and misconduct are not condoned at any level of research or competition. Such practices include but are not limited to plagiarism, forgery, use or presentation of other researcher's work as one's own, and fabrication of data. Fraudulent projects will fail to qualify for competition in affiliated fairs and the Intel ISEF.

Aditya Kendre	aditya	10/29/2019
Student's Printed Name	Signature	Date Acknowledged (mm/dd/yy) (Must be prior to experimentation.)

b. Parent/Guardian Approval: I have read and understand the risks and possible dangers involved in the **Research Plan/Project Summary**. I consent to my child participating in this research.

Nivrutti Kendre	Nkendre	10/29/2019
Parent/Guardian's Printed Name	Signature	Date Acknowledged (mm/dd/yy) (Must be prior to experimentation.)

2. To be completed by the local or affiliated Fair SRC

(Required for projects requiring prior SRC/IRB APPROVAL. Sign 2a or 2b as appropriate.)

a. Required for projects that need prior SRC/IRB approval BEFORE experimentation (humans, vertebrates or potentially hazardous biological agents).

The SRC/IRB has carefully studied this project's **Research Plan/Project Summary** and all the required forms are included. My signature indicates approval of the **Research Plan/Project Summary** before the student begins experimentation.

SRC/IRB Chair's Printed Name

Signature

Date of Approval (mm/dd/yy) (Must be prior to experimentation.)

OR

b. Required for research conducted at all Regulated Research Institutions with no prior fair SRC/IRB approval.

This project was conducted at a regulated research institution (**not home or high school, etc.**), was reviewed and approved by the proper institutional board before experimentation and complies with the Intel ISEF Rules. **Attach (1C) and any required institutional approvals (e.g. IACUC, IRB).**

SRC Chair's Printed Name

Signature

Date of Approval (mm/dd/yy)

3. Final Intel ISEF Affiliated Fair SRC Approval (Required for ALL Projects)

SRC Approval After Experimentation and Before Competition at Regional/State/National Fair

I certify that this project adheres to the approved **Research Plan/Project Summary** and complies with all Intel ISEF Rules.

Regional SRC Chair's Printed Name	Signature	Date of Approval (mm/dd/yy)
State/National SRC Chair's Printed Name *(where applicable)*	Signature	Date of Approval (mm/dd/yy)

Risk Assessment Form (3)

Must be completed before experimentation.

Student's Name(s) Aditya Kendre

Title of Project A Deep Learning Approach for Arrhythmia Detection

To be completed by the Student Researcher(s) in collaboration with Designated Supervisor/Qualified Scientist: (All questions must be answered; additional page(s) may be attached.)

1. List all hazardous chemicals, activities, or devices that will be used; identify microorganisms exempt from pre-approval (see Potentially Hazardous Biological Agent rules).

   Computational Computer

2. Identify and assess the risks involved in this project.

   Not Applicable

3. Describe the safety precautions and procedures that will be used to reduce the risks.

   Not Applicable

4. Describe the disposal procedures that will be used (when applicable).

   Not Applicable

5. List the source(s) of safety information.

   Not Applicable

To be completed and signed by the Designated Supervisor (or Qualified Scientist, when applicable):
I agree with the risk assessment and safety precautions and procedures described above. I certify that I have reviewed the Research Plan/Project Summary and will provide direct supervision.

Designated Supervisor's Printed Name | Signature | Date of Review (mm/dd/yy)

Position & Institution | Phone or email contact information

Experience/Training as relates to the student's area of research