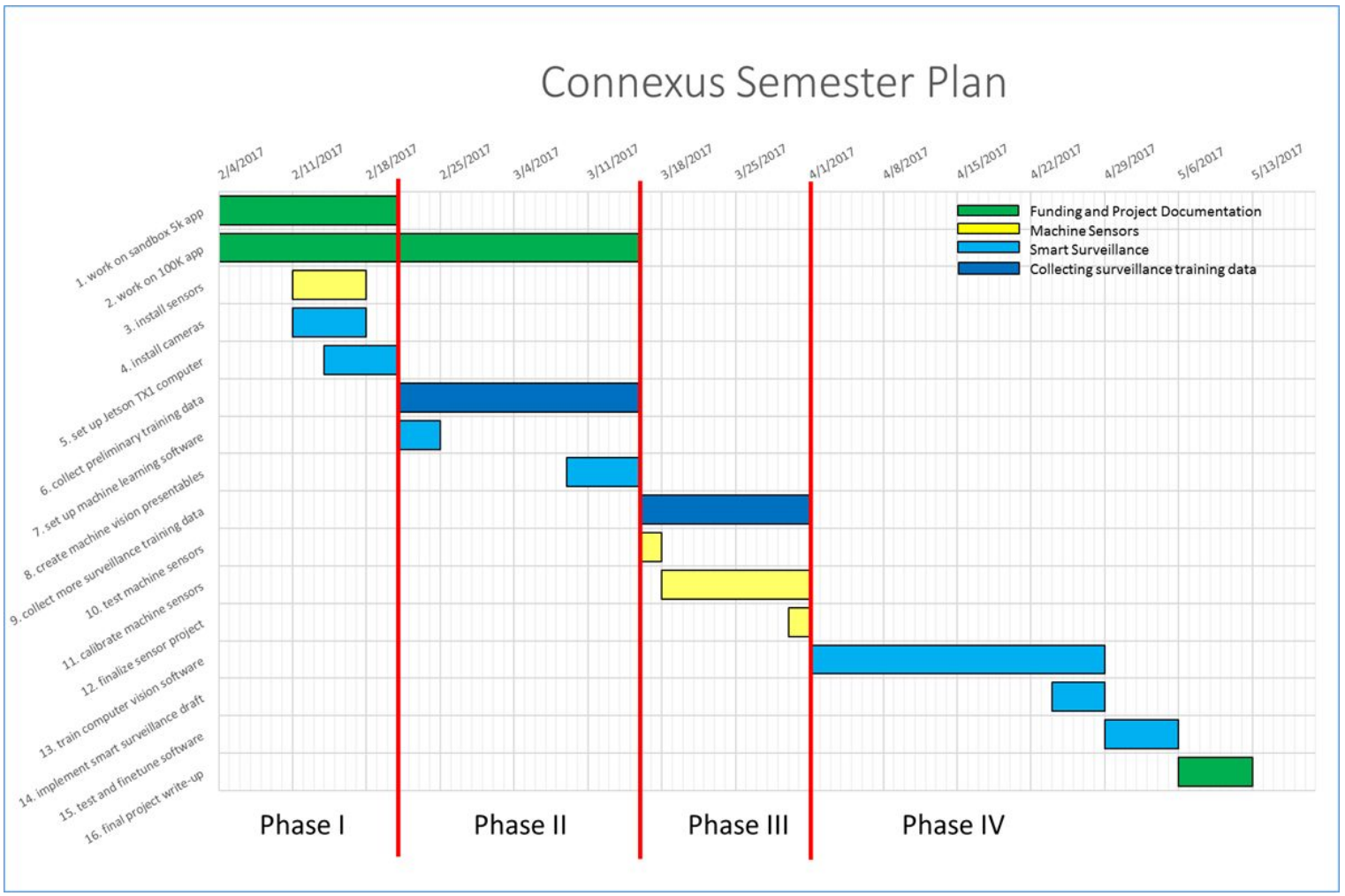
IDC Smart Safety Proposal

By Mubarik Mohamoud, Ryan Robinett, Brandon Benson

We are a team of undergraduate students, called Connexus, interested in applying machine learning and computer vision to automate systems. After speaking with the IDC machine shop managers, we have noted safety needs for the wood and metal room that are applicable to real-time monitoring:

1. Machines are not turned on between specified hours
2. Machines are monitored to track usage and maintenance
3. There are always at least 2 users when working in the shop
4. Each user is wearing safety glasses
5. There is no food or drink present

In order to achieve these five goals, we have a semester plan that consists of installing sensors and cameras in the machine shop, collecting training data for machine learning algorithms, and using computer vision to give safety feedback to shop users and shop managers. To meet these action items, we have outlines the major steps that we will take this semester in a GANTT chart. After this, the chart is explained in more detail. Finally, a working budget is included that contains our projected expenses for sensors, software subscription, and computers.



The first two items in the GANTT chart are funding applications that define phase I and phase II of the project (1-2). Before the end of Phase I we aim to purchase the required materials and go through installation and set-up in the machine shop (3-5). In Phase II we will begin by installing and preparing software, then collecting training data with the cameras and sensors (6-7). After collecting enough data, we will use video and preliminary machine learning to creating presentable video, not necessarily in real-time, that demonstrates the ability of the computer vision software (8). At this point, the 100K application along with the presentable video can be used as a project update to IDC. We will then enter phase III of the project which focuses primarily on machine sensors. We plan to use current sensors on each machine to give feedback about how often the machine is used and how much power it draws. This can be used to approximate maintenance cycles for each machine. Additionally, this provides more feedback for the computer vision, possibly allowing additional features of the surveillance cameras such as identifying when machines are on, but no users are present (9-12). In the last phase, we will use all of the data collected throughout the semester to train a robust computer vision system. This system can be implemented to give real-time feedback to users through an alarm or cutting power. We also aim to give real-time feedback to shop managers through live video feed. In order to complete these tasks, we have provided a list of materials below.

Semester Budget Estimate

category	type	price(estimates)	quantity	total	links
Cameras	Microsoft LifeCam Webcam	$60	4	$240	here
Machine current sensors	Hall Effect sensors	$30	12	$360	here
Machine learning computer	NVIDIA Jetson TK1	$200	1	$200	here
Software subscriptions	Windows 10 Pro	$200	1	$200	here
			grand total	$1000	

- Current Sensors: Since Oksana stressed the need to monitor the usage of the machines, we thought about general sensors could be usage for machines and current sensors (hall effect) make the most sense at point.
- Camera: There are many possible choices of cameras for our computer vision purposes, but we choose a model that is affordable and fits our resolution needs. We are still researching to pick the most reasonable cameras. If the IDC wants to invest in more expensive cameras for higher resolution, this would also be an option.
- Computer: The artificial intelligence part of the project requires a GPU computer. The JETSON TK1 is powerful but also affortable compared to other options (e.g TX1 ~$435).
- Windows 10 Pro: Ryan's personal computer runs windows 10 and to use some of the libraries our project requires (Docker to run Google's "tensor flow"), he will have to get the Windows 10 Pro subscription.

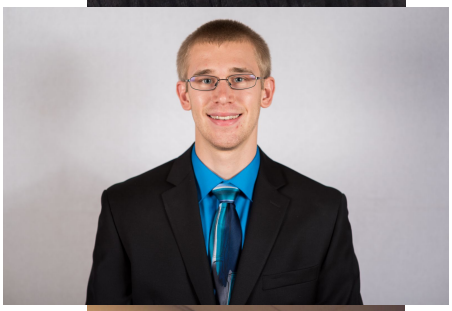
Conclusion

Our team, connexus, is excited to work on improving the safety of the IDC machine shop. Throughout the semester we will be talking with MIT EHS, MIT IRB, and many other machine shops to discuss machine shop safety, user privacy issues, and extending the applications of smart safety technology. We have a vision for a movement on campus that applies technology in a way the makes our campus a safer place for everyone, and we would be honored to work with you on making that vision a reality.

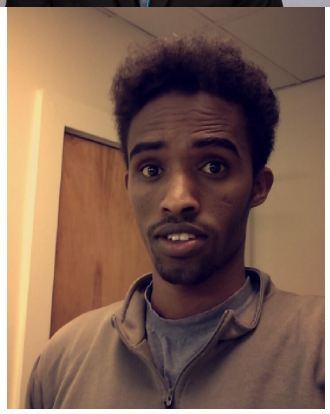
Sincerely,
Brandon, Mubarik, and Ryan

Our Team:

Ryan Robinett is a sophomore studying Computer Science and Molecular Biology. He volunteers as an data analyst at the Koch Center for Integrative Cancer Research, and his favorite areas in current research are automated reasoning, neural nets, and immunology.



Brandon Benson is a senior in physics and math with computer science. He has research experience in medical physics at Novascan LLC, high energy physics at SLAC, applied physics at Stanford Bioengineering Prakash Lab, and swarm control and AI at MIT CSAIL Lynch Lab. He enjoys entrepreneurship and has experience as a founder of Voca, an MIT based team working with Tanzanian farmers to start an avocado oil extraction business.



Mubarik Mohamoud is a senior in Electrical Engineering and Computer Science(EECS) exploring a wide range topics from artificial intelligence to analog electronics. He has done research in robotics and data mining and analysis as part of the MIT Racecar Platform and Media lab respectively. He plans to enroll in the EECS Master's program.