Meeting Minutes

Group 8 - C.A.V.E: Cave Assessment and Visualization Equipment

Sept. 11, 2025

Attendees: Abdul, Tabish, Berk, Andrew (online)
Notetaker: Nicholas

Agenda:

Team Technology

- Messaging/Communication: Teams
- Files- onedrive/sharepoint, eventually all Github (especially source files)
- CI/CD- optional since we're tron, should do some CI as is convenient and helps us, should be fire and forget
- Berk makes the repo
- Refining scope given by Andrew into an email to Dr. Wassyng for approval for Berk's entry into the group. Will then slightly rotate it into the group formation message required for the deliverable.
- Regular meeting during tutorial time (first hour), in person
- Andrew as Liasion, chair
- Nicholas as scribe
- Python for now, cython exists if speedup needed
- Can split computation into recording data/hardware interface, processing is separate task on another computer. Want to start over on that code, could pick fresh start. Various C/C++ libraries for these tasks
- Possible stretch goal to have a backend, database to back up info/sync btn pi and server
- Probably have a linter, Berk will see to it. Can follow formal convention, put issue number in commit message: https://www.conventionalcommits.org/en/v1.0.0/

Future Work

- Explore existing literature (aka the code from the last group, or Andrew's from last year)
- Figure out how the power delivery board works, determine whether we can reuse
- Sent out GitHub IDs to Andrew to share the code with us

Deliverables

- Next deliverable is September 21st, 10 days from now; form teams, project description.
- Berk has emailed the professors about his case, will move towards the team formation deliverable based on that.

Sept. 18, 2025

Attendees: Abdul, Tabish, Berk, Andrew (all online)
Notetaker: Nicholas

Project Goals and Development Plan

Plan:

- Work asynchronously throughout the week on goals, add requirements and constraints as they relate to goals.
- Work on this whenever have time over the next week
- Set main goal small, add stretch goals for other feasible
- Dev Plan rough outline
- Review existing materials from research project and last year's capstone, going over source code, power pcb, see what is useful for us
- Make contact with old capstone group to understand that power pcb end of Sept
- After, test sensors to see how well they work, and roll into proof of concept deliverable Oct
- For PoC itself, mainly need to demonstrate software can work with data from the sensors, fusing the two. Electrical and mechanical are minor considerations, test sensor→sfwr model
- critical point of POC is ensuring sensors work for our goal
- Mech, elec, sfwr designed/implemented in parallel, feedback between them, iterations
- Main shortcomings to improve this year for rev0: ToF camera/sensor was not really working last year
- Reusing Pi5, could improve electrical system for rev0. Could also want something more efficient for sensor collection, data processed elsewhere. Do PoC and then re-evaluate

Development:

- Andrew plugged in the TOF camera and Windows sees it as a serial device
- Sensor documentation:
  `https://wiki.sipeed.com/hardware/en/maixsense/maixsense-a011/maixsense-a010.html`

Deliverables:

Project Goals and Development Plan - Sept 28 (11 days)

Sept. 25, 2025

Attendees: Abdul, Tabish, Berk, Andrew
Notetaker: Nicholas

Project Goals and Development meeting (*deliverable on the 28th*)

- Break down document into chunks, one person is responsible for completing it, two more for reviewing it
- Finish writing sections by Saturday, finish reviewing by Sunday
- Add rough goals to doc together during meeting
- Also hash out the steps involved in project development
- Prioritize setting up Git repo, evaluate using Dr. Smith's template
- Split the work out, everyone has ∼2 writing items to complete by Saturday, 3-4 reviewing tasks

Oct. 2, 2025

Attendees: Abdul, Tabish, Berk, *Andrew (Away)*
Notetaker: Nicholas

Agenda:

GitHub

- Used Dr. Smith's template, has a lot extras/fluff that we won't probably use like in docs
- Main thing to keep is the action compiling the latex files, will be useful for future documentation
- All future docs in the Github as tex
- Convert meetings notes and commit
- Same for goals/development plan
- Use issues to track who does what -link commits to issues, assign to people
- CI/CD: some tools to autogenerate issues if there are problems with the code
- Use issues for actual tasks to complete in repo, ie meeting minutes, code additions, documentation
- Add issues for ci/cd, notes, etc.
- May be an issue with permissions, no one can assign issues or create commits

Action Items

- Github permissions from Andrew
- Add sufficient issues to get us to the PoC (Oct 27)
- Complete the setup tasks before the next TA meeting
- Meet with Giamou before PoC, possibly during this meeting time

Oct. 9, 2025

C.A.V.E Attendees: Abdul, Tabish, Berk, Andrew, Nicholas
Notetaker: Nicholas

TA Meeting - 3:45pm - Dr. Wassyng, Vasily Kapustin

Agenda

- Verify PoC deliverables
- Discuss main branch protection
- Talk about the previous years' attempt, what we can take from that

Minutes

- Went over summary of the project with Dr. Wassyng and Dr. Rapoport, cave mapping goal
- Got a hold of one of last years' group. On the topic of reuse, it's up to us how much to reuse. Build on other projects with most projects, just acknowledge.
- Last year didnt finish algos, apparently had trouble with the helmet. It didn't see everything they wanted, was unnatural to use.
- Talk with Giamou a lot to start- this will become difficult
- Easier to write your own algorithms than trying to debug someone else's. Will be easier to start fresh
- ToF sensor works with vendor software, in Thode
- Proof of concept deliverables- not a prototype, just think about what is critical for success. Show some kind of proof that we can overcome the main hurdle
- Quick and dirty, feasibility proof. Does not have to be used in final protoypes/iterations.
- Informal presentation, tell problem (1-2 of them) show why it works. Previous videos to base off off
- Written contract: submitted Friday Oct 31. Things that we are guaranteeing that we will have done. High level goals, no nice-to-haves, underpromise, overdeliver.
- *Berk arrives*
- Written contract is conditions for success; shouldnt be trivial.
- Do a good job on version control. Try and get (code) architecture done early, set interfaces (internal sw, sw/hw).
- Do sfwr early- some groups skimp on unit testing and just do integration. Having the lower level verification eases debugging
- Backups are a good idea, disable force pushes (history rewriting).
- Chat with Vasily, he's very good with software (and toasters). He is not usually at these meetings, more of an advisor. (they have other classes and commitments)
- Have a reasonably regular meeting with him. He'll be vocal about changes we should make.
- *Reviewing* and reusing their electronics counts for the electrical requirement- "debugging is more difficult than writing"
- Dont be as smart as possible when coding, because then you're not smart enough to debug it. Keep it simple. Optimize after it works.

Action Items

- Work on proof of concept over reading week break (due week of Oct 27)
- Work on written demo contract (due Oct 31)
- Talk with Dr. Giamou and our TA Vasily

Supervisor Meeting - 4:10-5:00pm

Agenda

- Plan future meetings
- Identify points of clarification
- Talk with Dr. Giamou about what we should do for the PoC

Minutes

- Before meeting with Giamou, talking about reading week plans
- Will meet online during the regular slot on reading week, to check in
- Simple slideshow with some of last years' stuff, whatever work we have done for the proof of concept.
- electrical distribution board appears to have been open sourced
- PoC: show sensor working with a laptop or Pi, fusion?
- Stick with MIT license
- Review the CI/CD settings so that we don't get 3 emails every time documentation is changed
- Should create a milestone for the PoC and start putting issues under that to distribute work
- Try out decomposing issues, see how the hierarchy works in Github- start big, break into small
- New/different sensors: keep current for PoC, change later if needed to achieve goals or requirements
- Make issues as we think of them, assign them as needed
- Can reconfigure sonarqube to ignore documents file, may disable actions for now
- Tabish can also help with unit tests; more of a later problem. Will know more about what to test once we have more code completed.
- *Meeting with Dr Giamou*
- Updating, telling him about deliverables. Need to figure out what the PoC pain points are.
- Getting a couple of the sensors integrated, have 3 weeks to work on PoC
- What went well last year and what didnt go well?
- Werent able to do point cload alignment with ToF sensors. Try and get them up and running or decide on different sensor, or choose brighter env.
- We found that ToF works, could work with the vendors software. Need to get it clean enough to do ICP, fuse with IMU.
- IMU as complimentary filter, use only for orientation. Gyro/yaw
- 2D lidar was working well indoor. ToF is supposed to help with low light

- To make point cloud, imu gives orientation, accumulate points from one position. Need ToF to do full 6dof.
- For us, lidar gets larger FoV point cloud that isnt ToF, which have narrower views.
- Start with ToF, get them up and running, ICP with them. DOn't need to fuse IMU yet, use with 2d lidar to build point cloud.
- Pose: orientation+position- 6 axes
- Andrew has academic resources for this form last year, textbook on state estimation. Andrew's literature review on subterranean mapping.
- *Andrew*- send us the resources
- Open loop estimation, trusting odometry from ICP.
- Did a demo with the ToF sensor, looks pretty good. Does well in middling lighting within Giamou's office.
- Consider other battery chemistries- LiFePO4?
- Decide on coverage of the two sensors, what fields of view are important. Side to side? Forward? experiment. No need for stereo, overlapping could interfere though
- Consider button to control when imaging, no need for constant movement
- Existing algos to fuse data, openCV, ICP
- For combining IMU with point cloud, do extended filtering. No loop closures. 2d slice not for space, for mapping
- Next meeting should be right after reading week or when PoC is mostly done, 2-3wks from now, would have to be online once his daughter is born. Meet online in November.
- Giamou is in person M/T/Th
- Mondays are a good day- 1:30-3:30, or 10:30-12:30. 20th or 27th depending on PoC, likely at 2:30pm.

Action Items

- PoC due Oct 30 - see above, mainly work on ToF. IMU later, then 2d lidar.
- Add Dr. Giamou to the GitHub - username mattgiamou

Oct. 16, 2025

Attendees: Abdul, Tabish, Berk, Andrew
Notetaker: Nicholas

Team Reading Week Sync Up

Agenda

- Figure out what we need to do for the electives over the next two weeks.
- Catch up on who has done what

Minutes

- PoC and contract is main deliverables
- Example contracts have been posted, they are short
- Some are more formal, could copy and paste format from examples
- Middle ground, or see what it looks like
- Currently using sensors with companies algorithm, only shows realtime map, no persistence
- Apparently are some sensors from the same company that would work well but are out of stock
- Electrical - Unsure what boards 2/3 looks like, may just be in bin with other stuff. Not sure if theyre still needed
- Figure out purposes of all the boards, write down
- Old groups code has also been added, need to go over their code to understand sensor interfaces
- Invited Dr. Giamou to the repo
- Created a github milestone to organize PoC
- Need fusion from IMU to create persistent map from ToF- should be main goal of PoC
- Ask Andrew to bring built PCBs for Nicholas
- IMU is BNO055
- Leaning towards using Pi4, reduced power requirements and we don't need the power onboard
- Some licensing issues for Sonarqube with C++?
- Cython again an option, or alternative static analysis tools
- Textbooks- will add a page with links/resources for us to use - `http://asrl.utias.utoronto.ca/~tdb/bib/barfoot_ser24.pdf`
- Go over SLAM, sensor fusion
- Document sensor setup so others can replicate- try docker image

Action Items

- Proof of concept due in 2 weeks
- Draft contract as a part of that
- Abdul will work on sensors - try and get raw data from sensor, analyze somehow into a single frame/capture
- Nicholas will dissect schematics
- Everyone should get familiar with last years' code, algorithms