

1. Title: Portable Door Lock

2. Background

Imagine the situation of a security conscious individual who frequently stays in hotels or AirBnbs. Often the authorities in these places may not be trustworthy and the individual would have security or privacy concerns. So, he would prefer a smart lock type system that is portable and can be attached on doors without requiring any heavy tools or damaging or scratching the door.

Tenants might also prefer to use a door lock system which would provide extra safety and privacy without requiring him to drill into the door as this would generally not be allowed by their landlord.

Also, a smart door lock would be highly useful in a communal setting like hostel rooms. In such surroundings, there is a lack of privacy, as anyone can enter our room. Also, if we are sleeping somebody entering our room may unintentionally disturb our sleep.

Further, if we are sleeping and our roommate wants to enter the room and it is locked, it is not possible for him to enter unless we wake up and unlock the door.

Another issue is that once smart locks are fixed to a door, they are not portable and cant be removed.

3. Novelty

1. Our door lock is the first door lock which is portable and can be attached to any door without drilling on the door.
2. It comes with features specific to hostel rooms which no other lock offers.
3. It has advanced features like capturing image when it detects motion and sending it to Telegram. Plus, we can control the lock using Telegram, too.
4. Advanced door locks offered from companies like Godrej require complex installation process, which is done by company personnel, so our door lock also reduces that problem by providing easy way of installation.
5. Currently available portable door locks cannot be used on our hostel doors as they require advanced doors and lack advanced features, but ours can fit both hostel doors as well as advanced doors.

4. Methodology

Firstly our idea to make a door lock was decided and then someone told us to integrate portability to it so that it can be used on any door without drilling which would be useful for tourists to attach it to any 2102 door. Then we divided ourselves into two teams, electrical and mechanical team. Electrical team decided which features were to be added in the door lock while mechanical team started to think of methods to attach the door lock to any door without drilling. Finally, the design was finalized, and frame was decided to be made of sheet metal and box to be 3d printed. As there was a lot of waiting for 3d printing, we decided to make it from acrylic. Then we made cardboard model of both box and frame and saw if our design worked or not. We realized that the frame was bending when we rotated it, making the grip

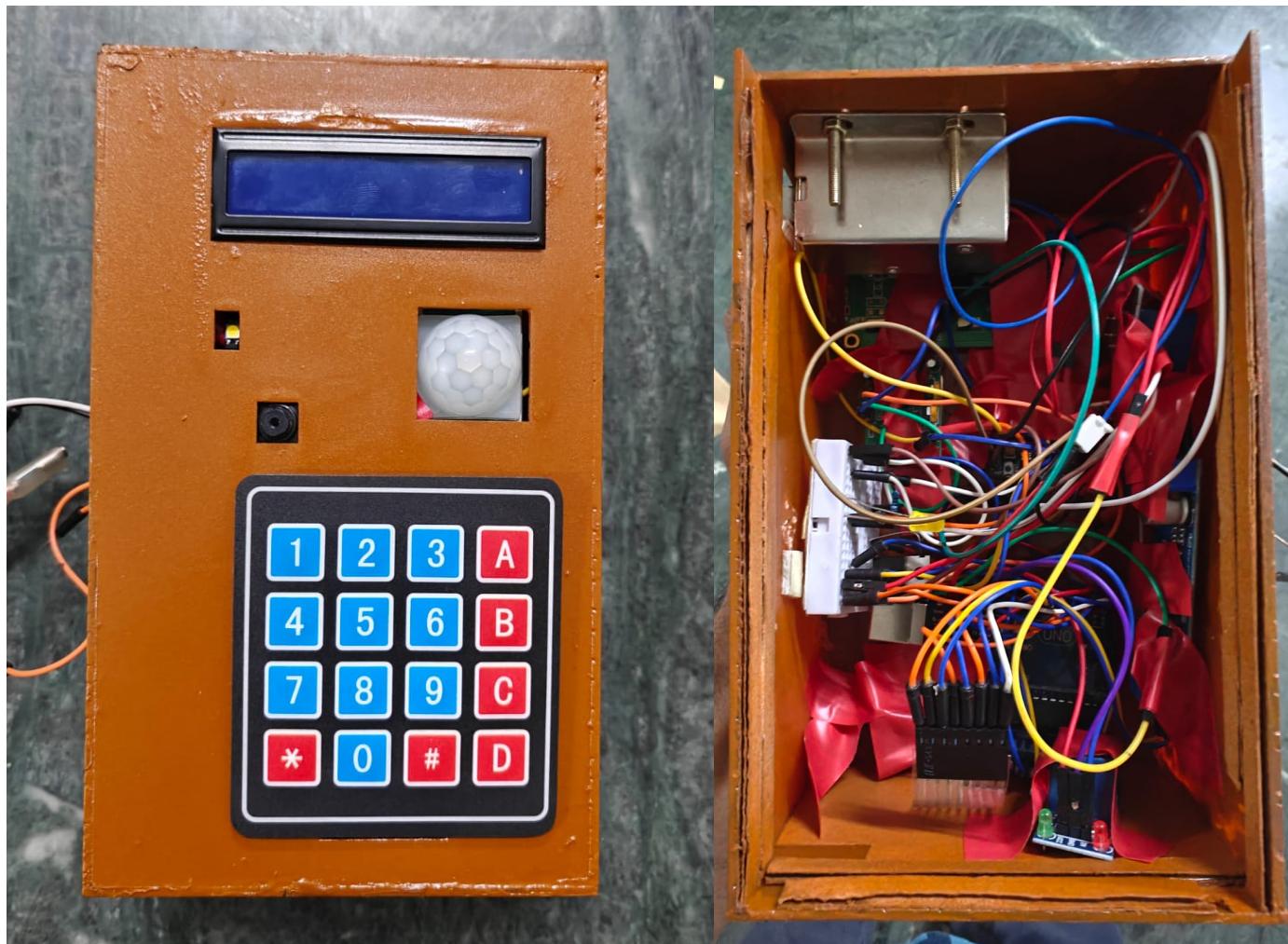
weak. So, we tested this for 0.5mm sheet whether it bends or not. We found out that it was bending too so we used 1mm sheet. Taking ideas from the cardboard model, we drew the layout for the cut. However, when we went to cut it, we came to know that there was no right tool to cut the 1mm sheet metal, so we thought about using a water jet cutter at the makerspace. There they guided us to use a jigsaw. With the help of jigsaw, we cut the sheet metal, drilled holes and bent it into shape. After that, we tried to weld nuts onto it but it didn't work out so then we used Mseal to attach them instead. For the box part, we took inspiration from the cardboard box and made CAD model for laser cutting. Then we assembled the box with glue and arranged the electrical components inside.

5. Result / Work Done

Our door lock currently has its frame made up of 1mm sheet metal.



Inside this frame, we have a box made up of acrylic sheet where we put the electrical system.



The box fits perfectly inside the frame, designed so that it can't be removed when the door is locked.



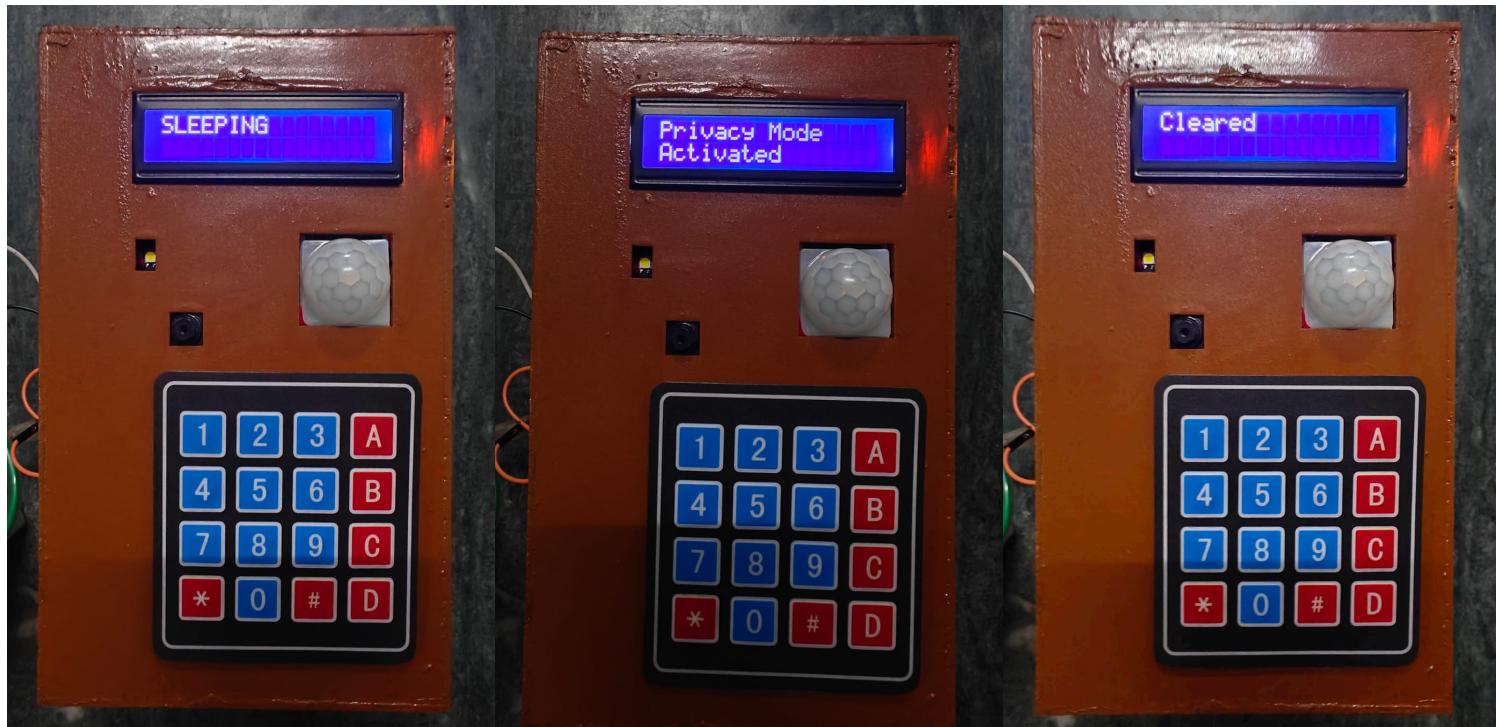
To attach the frame to the door, we use bolts that can be adjusted easily.



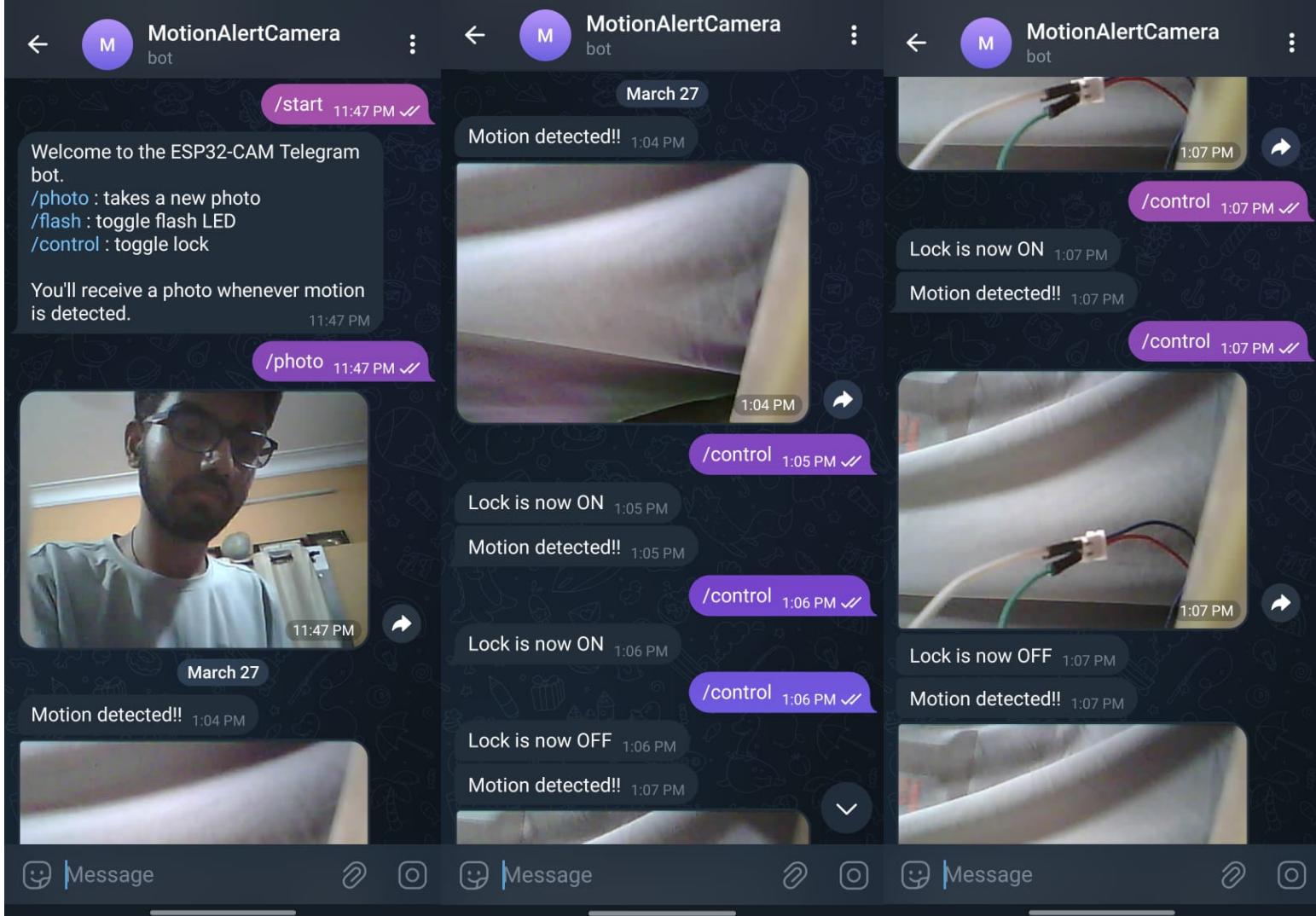
Our locking mechanism works on the principle that when it is in the locked state, we are unable to open door as the lock collides with a plane surface of the frame.



Our door lock includes a keypad for locking along with a sleeping mode in which it displays “Sleeping” and a privacy mode that waits 5 seconds before opening the door when someone knocks. We also have a camera and PIR sensor in our door lock.



We have also created Telegram bot for it so when there is a motion, it sends the photo to the Telegram bot and through this bot, we can control the lock by typing “/control”. By typing “/start”, we get to know about all the features. By “/flash” we can start the flashlight and by “/photo” we can get a photo.



6. Discussion

In making our portable door lock system, our team explored a couple of ideas to securely attach the door lock system to different types of doors. While our initial brainstorming sessions resulted in only a couple of ideas, we evaluated each of them based on their user-friendliness, feasibility and strength.

The first idea was supporting the lock from above the door. It seemed like a good option at first, however, we also noticed some weaknesses, as the frame of the door lock would have become too large because it had to be brought from the top of the door to the middle.

The second idea's design is such that it passes through the door. Although the locking frame would be still bigger, but with the help of a bolt at the back, we can adjust it.

After carefully considering both of the options, we found that the second idea stood out as the best choice. This doesn't require any complex installation, is easy to adjust on the door without any kind of drilling and it could also be used on doors opening inwards and outwards. This idea combines all the three things; smart lock, easy to use and portability. This idea based on a smart door lock mechanism will help to open the door automatically and safely. This easy portability makes it convenient for use in hostels or other places where the existing door lock might not meet the desired security standards.

As we worked on our project, we faced a few technical challenges and problems. We had to deal with things like making sure our system worked with different types of doors and figuring out how to build it with limited resources. As for the electrical work of the project, the solenoid door lock was our first choice, however, it didn't function properly and would require high voltage to operate, which was getting difficult for us to integrate into the system. Then we tried using a face detector lock, but it wasn't safe because it would open with anyone's face. So, we switched to the PIR motion concept where we integrated a PIR sensor to detect if someone comes in close proximity to the room and send notifications to mobile phones when someone approaches. For this purpose, we wanted to use an IoT software called Blynk, however, Blynk is a paid service, so we used Telegram instead of it.

Looking forward, we know that what we've learned from this project will guide us in the future. Each problem was a chance for us to learn and get better. By working together and coming up with new ideas, we managed to solve these problems and improve our plans along the way.

Our project taught us a lot about teamwork and how important it is to communicate openly and support each other. Apart from learning technical stuff, our project also gave us a lot of practical experience. We got to try things out and learn by doing them ourselves.

7. Applications

Many travellers who move around a lot often feel unsafe when staying in hotels or Airbnbs. Our survey confirms this. So, they can carry our door lock with them, without drilling or using heavy equipments they can attach it to any door.

Some tenants are not allowed to drill and modify their door so they can also use our door lock and its advanced features

It comes with sleeping mode in which it displays "Sleeping" on LCD screen. This lets our friends know we're sleeping and shouldn't be disturbed.

With the help of privacy mode, nobody can enter our room directly. If the door is open, it takes 5 seconds to open the door. This gives us time to get ready when someone is entering in our room without knocking.

This can also be used by professors and anyone outside their office for privacy.

8. Future Directions and Further Improvements

1. Instead of a solenoid lock we can use a custom made lock
2. The size of the current box is too big which could be reduced by using PCB. Right now, we have directly put the circuit in the box. If we switch to a PCB, the thickness of the box would decrease significantly.
3. We can make an app to control the lock which can have features like sleeping mode and privacy mode. We can also introduce a time-blocking feature in the app, restricting access for specific individuals after a certain time. In addition, face detector mechanism can also be

added.

5. We can make the lock frame out of lightweight material.
6. For power, we can use a small battery that fits inside the box.
7. To ensure access in emergencies, micro-USB port can be added if battery becomes dead to charge the lock.
8. We can also integrate a bell in the lock so that it can also be used as a bell.